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COCONUT ESTATE MIXTURES.

In continuation of our article in the June number we propose in this issue to examine the composition of twelve mixtures used by coconut planters in Ceylon. Following the method we previously employed of reducing phosphoric acid to the unit value of 100 the proportion of the principal ingredients works out in these twelve manures as follows :—

Ratio of.	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	Mean.
Nitrogen ...	43	26	31	51	—	19	85	27	30	51	129	17	46
Phos. acid ...	100	100	100	100	100	100	100	100	100	100	100	100	100
Potash ...	71	35	41	74	109	23	250	9	—	—	—	10	69

Mixture No. 1 consists of castor cake 4 lb., groundnut cake 2 lb., fish manure 2 lb., bone meal 6 lb., sulphate of potash 2 lb.=16 lb. per tree. Our correspondent, in this case an experienced coconut planter who has made a special study of manures, writes that he considers it a suitable general compost for coconuts. The author of No. 7, also an experienced planter, states he proceeds on the principle of returning to the soil the elements of fertility removed by a crop of 3,000 nuts per acre per annum. His mixture is: Castor cake 420 lb., fish 105 lb., bone meal 140 lb., sulphate of potash 175 lb.—12 lb. of the mixture being applied per tree. These two mixtures present a great contrast. Reliance is placed in the first case principally upon phosphoric acid, in the second upon potash. No. 12, a mixture particularly prized by the estate concerned, is composed of

kainit 2 lb., castor cake 2 lb., steamed bone meal 10 lb., basic slag 1 lb.=15 lb. per tree. Phosphoric acid is here given even greater prominence. Nos. 8—11 are from one source. With regard to No. 8 our correspondent, a leading Ceylon Visiting Agent, writes "this mixture (with slight variation during the last two years owing to scarcity of supplies) has been used on an estate for 6 years for practically the same number of bearing palms. It consists of groundnut cake 200 lb., nitrate of potash 30 lb., bone meal 170 lb., steamed bone meal 280 lb., concentrated superphosphate 25 lb.=705 lb. The average yield on the estate in 1910 was 19 nuts per tree; in 1915, 56 nuts per tree. Liberal quantities of burnt coconut ash and cattle manure have been used in conjunction with the compost.

The outstanding feature of these mixtures is the large proportion of phosphoric acid employed and it is manifest that planters consider this the dominant ingredient for coconuts in Ceylon. The author of No. 8 indeed writes "I personally have always found (phosphoric acid) essential for the production of heavy crops." Great weight should in our opinion be attached to this general partiality for phosphoric acid on the part of experienced planters working independently of each other. The poverty of most Ceylon soils in phosphoric acid, to which we alluded in our June number, has probably been an important, even if unrecognized, factor in the result.

When we turn to the records of our experiment stations and those of other countries we do not find they support this belief in phosphoric acid as being the dominant manure for coconuts.

In the March, 1915, number of this journal we analysed some of these records and found that of the three principal manurial ingredients, potash seemed to exert the best influence. Later records seem to bear out this to some extent. In the Pitiakande Experiment Station, the records of which were published in the May number of this year, the average yield of nuts in 1915 in plot No. 7, phosphoric acid omitted, was 20 per cent. higher than that in 1914. On the other hand plot No. 11, potash omitted, decreased in yield 28 per cent. At Chilaw, comparing the January—June picking of 1915 & 1916 the phosphoric acid plot (No. 4) increased by 48·4 per cent., the potash plot (No. 5) by 81·2

per cent. At Negombo the trees are not yet in bearing but the eye can detect in the growth of the young palms the marked effect of potash. Against this we must put the records of the old coconut experiments at Peradeniya for 1915. Potash increased the yield from 25 nuts per tree in 1911 to 28 in 1915—12 per cent.; phosphoric acid from 24 to 39—62 per cent. In these experiments (vide T. A., May, 1916) nitrogen did best of the three, nitrate of soda (alone) which previously had done indifferently, increasing the yield 94 per cent. (17 to 33 nuts per tree). Previous records of this experiment seemed to show that potash was exercising the best influence (T. A. March, 1915).

With regard to the question of phosphoric acid it is to be noted that not only is the actual quantity small in Ceylon soils as indicated by the percentage, but the proportion is low as compared with nitrogen, as the following table shows :

Ratio of.	Average Ceylon soils.	Typical loam.
Nitrogen	235	44
Phosphoric acid	100	100
Potash	203	210

This perhaps helps to explain to some extent the influence that applications of phosphoric acid appears to have on coconuts in Ceylon judging by its popularity with planters. The proportion of phosphoric acid to nitrogen is on an average only one-fifth as much in Ceylon soils as in a typical fertile loam in England. We may have here a case in which the "Law of the Minimum" is in operation.

R. N. L.

CREPE TAKANA CABBAGE.

Seeds of the above were received from the Yokohama Nursery Co., through Peradeniya, last November, and the plants have done very well. Seeds have been collected from the plants. No Club Root was noticed, probably owing to the fact that no cruciferous vegetables have been grown on the ground where this cabbage has been tried.—PROGRESS REPT. HAK. BOT. GDNS.

COCONUTS.

COCONUTS IN BRAZIL.

The author of TROPICAL BRAZIL, referring to the possibilities of the coconut industry in that country, says:—

"The coconut palm attains a great size on the sea-shore and by its presence indicates the suitability of the climate and soil for this culture. Magnificent palms flourish all along its 2,700 miles of coast. Although there are a very large number of trees along the coast, they are as yet little cultivated, and not until the serious attention of organised industry, backed up by adequate capital, is attracted to it can we look for an output such as might fairly be expected from the wide areas available for the industry."

We have reason to believe that the development of the coconut industry in Brazil is likely to be considerably facilitated by the operations of certain powerful Syndicates which have now expert agents on the spot to make the necessary arrangements for exploitation on a scale commensurate with the resources of this wealthy country.

According to a leading expert on Brazilian tropical produce, the coconut grown in those regions is, in shape fairly oval, measuring on a fair average six by five inches, and with a greater depth of meat than is found in the Malabar nut. The Brazilian nuts vary, of course, in size, in quantity of flesh, and percentage of oil, according to the regions in which they are cultivated. They are not at all sweet, and for this reason should be very good for margarine manufacture.

One of the most prominent regions for coconut growing is in the island of Camahu, near the capital city of Bahia. The Bay ranks immediately after Rio de Janeiro and Bahia as one of the largest and best bays in Brazil.

It is destined to be of considerable commercial importance by the organised development of the great natural resources of the surrounding country. Labour is abundant and cheap, the sole reason that has hitherto prevented the complete development of this section of the country being the absence of the necessary capital. This serious difficulty is now being overcome. We possess the strongest evidence that the attention of British capitalists is being attracted to the vast, prolific and hitherto unexploited coconut areas of tropical Brazil, with a view to the establishment of plantations conducted upon that ultra-modern, scientific, intensive system of cultivation which has elsewhere yielded such excellent results. When such enterprises are judicially and economically organised, those who participate therein, as capitalists or shareholders, should reap a very rich reward. We understand that the State of Bahia, anxious to see its vast riches systematically developed, is prepared to co-operate, as far as possible, not only by granting subsidies, but by exemption by State and Municipal taxation over a long period. Brazil enjoys the advantage of a strong Central Government. Each of the twenty States composing the United States of Brazil is administered at its own expense,

independently of the Central Government, save for defence, the maintenance of law and credit, and certain fiscal arrangements. As Brazil lies mainly south of the Equator, and in a hemisphere where there is a greater proportion of sea than land, its climate is generally more cool and moist than that of countries in corresponding latitudes on the northern hemisphere.

Those who know Brazil appear convinced that the country could, and probably will, develop a coconut industry worthy of rivalling in time the great Brazilian Rubber industry.—THE EMPIRE.

COCONUT EXPERIMENTS IN MADRAS.

The Government of Madras have sanctioned the starting of three experimental stations on Government vacant land in the Kasaragod taluk of the South Canara district on the three distinct types of soil on which coconuts are commonly grown. It is also proposed to lease two suitable plantations, chiefly for the study of cultural and manurial problems—one in the Kasaragod taluk and the other at a place in the Malabar district to be selected hereafter. This is a step in the right direction. The area under coconuts in this Presidency is approximately 794,000 acres of which 81 per cent. is found on the West Coast. The annual total production of nuts in Southern India, including Native States, is in the neighbourhood of 1,000 millions. Excluding the years affected by the war, the average value of the exports of the produce of this tree for the five years ending 1913–1914 was 224·6 lakhs from Madras ports alone. There is also a very large internal consumption. It is beyond all others the commercial crop of the thickly populated West Coast. West Coast copra, commercially known as Cochin copra, still commands the highest price of any on the world's markets. It is, moreover, a crop mainly on account of its oil, which is yearly becoming of increasing importance in the world's market. It may become exceedingly important industrially in India if anything comes of the idea of coconut ghee. It is of great importance therefore that everything should be known about the coconut tree which would be of value to the agriculturist.

But there is very little accurate information available. Coconuts are surface feeders and respond readily to manures. Thus there is need for trials of various manures and on different classes of land. There are also considerable differences between different countries in the manner in which manures are applied to the trees. The manurial question also has two aspects according as the manures may affect quantity or quality of copra or both. There is also a wide range in the various cultural methods adopted, e.g.. cultivating the whole land and root pruning. There are about four or five kinds of trees generally recognised on the West Coast as belonging to different varieties. But varieties do not by any means come true to type. Taking it that the main object in view is to increase the quantity of copra and improve its quality, there is obviously work to be done on varieties, which of course means new plantations. It is said that the retting and preparation of coir is not now done so carefully or well as in former years. In these circumstances, the experiments decided on by the Government should command the hearty approval of all agriculturists in India.—THE WEALTH OF INDIA

COCONUT PESTS IN FIJI.

This is a report of the visit of the Government Entomologist to the chief coconut districts of Fiji between January and April 1915. The spathe-boring moth was found to be common throughout the districts and especially troublesome at Vuna, Nagasau and Vunavessa. The spathes enclosing the inflorescence are penetrated by the larvæ of this species. The larvæ feed on the flowers and when mature pupate a short distance below the surface of the soil. The adults emerge in from 22 to 25 days and egg-laying begins soon after emergence. *Promecotheca reichei* (coconut leaf-miner) was observed in some plantations, but on account of the high degree of parasitism, probably cannot be regarded as a serious pest. Stick insects (*Graffca cocophaga*, Newp.) were abundant, extensive damage being caused in some cases. Since the eggs are dropped on to the ground by the female, it is advisable that weeds and grass for a distance of about 12 feet round the trunks of trees should be cut and burned. Magpies introduced into Taviuni some time ago are thought to keep the pest in check in the south part of the island. Bud-rot was found in a few localities in Taviuni, and it is recommended that infected trees should be destroyed. From observations made on the island of Laucala, the author is of the opinion that the exceptionally heavy yield of fruit was correlated with the swarms of bees present. It is considered that the introduction of bees into other plantations is worth a trial.—REVIEW OF APPLIED ENTOMOLOGY.

COCONUT MEMS.

The coconut is doing its bit in the war. Between the coir jacket and the shell of the ripe nut is a small quantity of light cream-coloured powder — the finest *absorbent* ever discovered. This powder is being keenly bought up by makers of *explosives*.

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An expert has just expressed his conviction that had it not been for the providential introduction of coconut butter the dairy product would now stand at 4*s*. per lb. in London. The poor owe our coconut experts a debt of gratitude!

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A full grown, well developed coconut palm in Brazil is expected to bear 240 nuts per annum, or at the rate of 20 per month. Some trees bear as many as 300 nuts within the year, but this is not, of course, the rule. So far the coconut industry in Brazil has not been developed with any enterprise, but this state of affairs is now being remedied, and we may expect from these regions some excellent results, owing to the enterprise of some important wealthy syndicates now engaged in the industry.

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In well favoured parts of the Philippines as many as 250 to 300 nuts have been obtained per tree. On a moderately well cultivated plantation a crop of 100 nuts is not unusual. It takes 250 to 325 of these nuts only to make a picul, and there are sixteen piculs to the ton, so that means 4,000 to 4,500 nuts to the ton of copra. Some claim, with very large nuts, that it takes only 200 nuts to make a picul.—THE EMPIRE.

PESTS: THE COCONUT PALM IN TRINIDAD.

VARIOUS INSECTS ATTACK COCONUT PALMS IN TRINIDAD.

Rhynchophorus palmarum, L. (gru-gru beetle) is attracted to trees which have been wounded or are suffering from fungoid or bacterial disease. The larvæ are preyed upon by the larvæ of an Elaterid and a Histerid. Control measures include the tarring of wounds and the burning of cut branches. *Rhina barbirostris*, L. (bearded weevil) attacks unhealthy trees. The larvæ are preyed on by the larvæ of an Elaterid and parasitised by an undetermined Tachinid fly. Palms which have been burnt should have the charred parts cut out and should then be treated with crude oil, tar, or a stiff paste of white lime to which is added lead arsenate paste in the proportion of 5 lb. to 50 gals. lime. The so-called flaming of trees for disease should be discontinued. *Metamasius hemipterus*, L. (small weevil borer) is a secondary pest generally associated with *R. Palmarum*, and has the same natural enemies. *M. obsoletus*, Gyl., *Xyleborus affinis*, Eich., and *X. confusus*, Eich. (shot-hole borers), are treated in the same way as *R. barbirostris*. *Strategus alœus*, L. (rhinoceros beetle) attacks young palms by burrowing into the stem from the base upwards. The larvæ are attacked by the green muscardine fungus and by *Cordyceps* sp. Breeding can be prevented by burning rotting stems. *Enema endymion*, Chev., *Phileurus didymus*, L., *Passalus interruptus*, L., and *Scalmus interstitialis*, Eich., are also recorded pests.

Brassolis sophoræ, L. (coconut butterfly) may become a serious pest when not checked by natural enemies. The latter include an undetermined egg-parasite, a Tachinid parasite of the larva and a Chalcid parasite of the pupa. The insect can be controlled by burning the nests of the larvæ and by spraying with lead arsenate in the proportion of 4 lb. to 50 gals. water. *Castnia licus*, Drury (giant moth borer) feeds on the soft tissues of the developing fronds. Attacked leaves usually turn yellow, and the larvæ, which are found at the base, can be cut out and the wound treated with tar or crude oil. *Sibina modesta*, Cram., *Automeris liberia*, Cram., *Hesperus* sp., and *Tortrix* sp., occur occasionally on the coconut.

The scale-insect *Aspidiotus destructor*, Sign., is associated with the ant *Azteca chartifex* and may cause serious injury to mature trees. It is attacked by a Hymenopterous parasite and by the predaceous Coccinellids, *Azya trinitatis*, Mshl., and *Cryotognahta nodiceps*, Mshl. The nests of the ants should be cut out of the stem and the wounds painted with crude oil or tar. The scales can then be sprayed with any insecticide. *Icerya montserratensis*, Riley and Howard (Montserrat fluted scale), *Vinsonia stellifera*, Westw. (star scale), *Pinnaspis buxi*, Bouche (long scale), *Pseudococcus nipæ*, Mask. (yellow mealy bug), have also been met with on coconuts. The last-named is associated with an ant, *Camponotus* sp.

The following Aleurodids occur in small numbers:—*Dialeurodicus pulcherrimus*, Quaint, and Baker, *Dialeurodicus* sp., *Aleurodicus cocois*, Curtis, *A. trinidadensis*, Quaint. and Baker, *Aleurodes* sp., and *Paraleurodes* sp. *Heliothrips hæmorrhoidalis*, Bch., is occasionally found on the leaves. The leaf-cutting ant, *Atta cephalotes*, L., occasionally defoliates young plants and *A. octospinosa*, Gunther, removes the male flowers. *Eutermes* sp. and *Calotermes* sp. breed in decayed portions of the trunk. *Tropidacris dux*, L. (giant grasshopper) has been occasionally recorded on coconut.—REVIEW OF APPLIED ENTOMOLOGY.

RUBBER.

CEYLON RUBBER RESEARCH.

These experiments are being carried on in conjunction with a group of plantations and the Imperial Institute in London, an arrangement which secures the confidence of planters, and ensures the advantage of independent investigation at home under conditions similar to those experienced by British manufacturers, with whom the Imperial Institute keeps in touch. The samples of rubber destined for vulcanization by the Imperial Institute have been prepared by MR. L. E. CAMPBELL, Rubber Research Chemist, those intended for direct comparative test being made from bulked latex collected in one day from reserved trees. In experiments of this nature uniformity of preparation is a very necessary condition if all suspicion of subsidiary influences is to be eliminated, and this condition has, in the case of our rubber research work, been fulfilled. MR. CAMPBELL worked through a scheme of preparation designed to cover the whole of plantation practice in the manufacture of thick and thin crêpe, smoked sheet, and block. It included preparation by acetic acid and other coagulants in varying strength and degrees of temperature; the effect of formalin and other re-agents for retarding coagulation; and rubber from old and young trees. 360 samples in all have been prepared, and reports received on 140 of these.

The results, as far as they have gone, are set out by MR. CAMPBELL in his report. They go to show that, as to the main features, there is not much the matter with plantation practice. Acetic acid is about the best coagulant that could be used. The quantity necessary varies according to the quality of latex, the limits in Ceylon being from 1 part of pure acid to 600 parts of pure latex, in exceptional cases to 1 in 900, the usual proportion required being about 1 to 800. There is no doubt, however, that on some plantations little heed is given to the correct mixing of the coagulant, which may vary in strength from day to day, and this accounts for a good deal of trouble in working. Some system of co-operation between planters should be devised, under which more uniformity in strength of acid used could be obtained. Every factory should possess glass measuring vessels, in order that the acid may be added accurately and stock solutions made.

Much of the prejudice against crêpe would appear from our investigations to be unfounded. Crêping does not seem to injure appreciably the quality of rubber as indicated by tensile strength and elongation, though the first few workings of the fresh coagulum lengthen the time of cure.

The testing plant of a large and well-known manufacturing firm in England is being so arranged that their tests may be comparable with ours at the Imperial Institute. This co-operation will ensure that our work is conducted along practical lines.

EFFECT OF TAPPING ON FOOD RESERVES OF HEVEA.

These investigations, the advisability of which was first indicated at a meeting of the Committee of Agricultural Experiments in March, 1913, have been carried by MR. L. E. CAMPBELL to a definite stage, though they are not

yet concluded. We were quite ignorant of the effect of tapping on food reserves, and apprehensions were felt that in the case of some of the systems in vogue permanent injury to the trees might eventually result. Trees under heavy and light tapping were selected and effects studied for a year, with the result that with careful tapping and a small number of cuts there were no grounds found for the apprehensions entertained. Starch was not withdrawn from wood or bark, except in the immediate neighbourhood of the tapping cut; and this limited and local withdrawal had apparently no injurious effect upon the tree. Of the different systems of tapping, the evidence was in favour of a change-over system with a single cut over half, a third, or one-quarter of the tree's circumference. From the point of view of bark renewal there was presumptive evidence in favour of the now popular system of changing the cut over from one side of the tree to the other at intervals of some months, usually six.

RESTING PERIOD OF RUBBER TREES.

MR. CAMPBELL has also carried out investigations into the storage of plant food at different seasons of the year, with a view to determining whether the period chosen in Ceylon for resting trees corresponds in time and in length with that period during which the starch reserves of trees is most heavily drawn upon. Rubber trees are, as a rule in Ceylon, rested when they winter or shed their leaves, tapping being resumed again when the new young leaves appear. This wintering time usually lasts for about six weeks, in February and March; but during this period, when the trees under observation by MR. CAMPBELL were leafless, the amount of starch stored in the bark and wood showed no signs of decreasing. Withdrawal of starch began with formation of new leaf, attaining its maximum when the new leaves were fully formed. The cells showed no signs of replenishment till three weeks afterwards, and complete recovery did not take place till a further two months had expired. It has been shown that though the influence of tapping upon reserves of starch is very localized, yet some influence is exerted, and MR. CAMPBELL recommends that tapping be suspended during the time occupied by the tree with new leaf formation, and for a period of at least three weeks afterwards. This would contribute to the welfare of the tree by relieving it of one drain upon its resources while another temporary but severe drain was being exercised, and is the manifest course suggested by these investigations.—ANNUAL REP., DEPT. OF AGRIC., 1915.

BARK ROT IN HEVEA.

Considerable anxiety arose during the year among rubber planters in certain districts, owing to the reappearance of a diseased condition on renewing bark of rubber trees, which has received the name of "bark-rot." It has been the subject of frequent discussion at our committee meetings, fears being entertained by planters that it was infectious. It was described by one planter in September at that time as the most serious disease the rubber planter had to contend with. The symptoms are small black vertical lines that appear on the newly tapped surface and continue up into the renewing

bark and down into untapped bark. MR. BRYCE's researches have afforded no grounds for supposing bark-rot to be infectious. He still has the matter under investigation. The rot is prevalent only in the wet seasons, tending to disappear with the approach of dry weather. Measures now being tried by MR. BRYCE are designed to accelerate the healing of the wound caused by bark-rot. Preventive measures have not so far been determined, owing to the fact that little is known of the cause of this diseased condition.—ANNUAL REP., AGRIC. DEPT., 1915.

AJOWAN.

(Carum copticum).

An annual Umbelliferous plant widely cultivated in India for the seeds which are valued for their medicinal properties. The seeds are of importance commercially as the source of Thymol, a well-known antiseptic.

The technical laboratory of the Department of Industries, United Provinces of India, has issued a circular advocating the manufacture of Thymol in India, stating that it can be undertaken without any difficulty where the raw material is so plentiful, and that very good samples have been obtained as a result of experiments conducted at the laboratory. The circular says in part: Thymol was sold before the war at five to six shillings per pound. The price rose enormously soon after the supplies from Germany were stopped, and not so long since was quoted at 30*s*. per pound. It is obvious that the manufacture of thymol in India at the present time should yield a good return. Even under normal conditions there appears to be no reason why thymol should not be made in India at least as cheaply as elsewhere, seeing that we have the raw material in our midst, and a small company has recently been established at Dehra Dun for its manufacture. The apparatus required is simple and inexpensive. The demand for thymol both in India and in Great Britain is great, and there should be no difficulty therefore in finding a ready market.

It may perhaps be recorded that from seeds of this plant forwarded from the Royal Gardens, Kew, to the Imperial Commissioner of Agriculture in the West Indies, plants have been successfully raised in St. Lucia, growing to a height ot 2 ft., and flowering freely. The present value of Ajowan seed in the London drug market ranges from 18*s*. to 24*s*. per hundred-weight.

—J. M. H. IN KEW BULLETIN.

[This is the Sinhalese *Asamodagam*.—Ed. T.A.]

TEA.

CONTOUR PLANTING OF TEA AND TERRACING.

G. D. HOPE.

The most fundamental difference between the methods of planting in Java on the one hand, and in Ceylon and, speaking generally, in India, on the other is this invariable custom in Java of planting the bushes round contour lines on slopes. In Ceylon, which affords a good parallel, bushes are always planted in straight lines irrespective of the direction of the slopes, and, as far as I could determine, the original alignment chosen has usually been a matter which has received little or no consideration.

The two methods are so diametrically opposite, and modify in such a far-reaching way the work done on the gardens subsequently, that it is worth enquiring closely into the reasons which have led to the one method being adopted in one country and the other in the other. I think it very probable that, in the early days of planting in Java, terracing and planting on contours was copied from the methods employed by the Javanese in their domestic agriculture. Planters are often conservative in such matters, and this method having become firmly established, no examples are to be found of the adoption of any other. It is indeed remarkable that terracing has not been copied similarly in Ceylon from the terraced rice fields which are so picturesque a feature of the journey from Colombo to Kandy. In my opinion the method of planting along contour lines is the right one. If in addition to this the land be terraced, or other method of checking loss of soil by wash be adopted, the deterioration of the estate by loss of surface soil from slopes will be very largely prevented.

The difference in the attitude towards the question of wash and its prevention held by planters in Ceylon and India on the one hand, and by those in Java on the other, is that the former with a few exceptions lay out their gardens first and then attempt to make the system which they adopt to prevent wash fit into it, while the latter lay out their ground after clearing it according to a scheme designed primarily for the prevention of wash, and then plant their bushes in contour lines to fit in with the scheme. It seems to be obvious that the latter is the sounder method of the two in all cases where the difference between the fertility—and thus in the capital value—of the surface and subsoil is marked.

In Java, be it said at once, nearly all the tea is on sloping ground, and large stretches of level ground are very rarely seen, so that practically speaking one or other of the systems I am about to describe are in existence everywhere. The planting is invariably in contour lines and is fairly close. so that there are usually at least over three thousand bushes to the acre. This method of planting, it will be appreciated readily, fits in much better with the methods which are adopted to prevent wash than does linear, square, or triangular planting, and this is one of the chief points in its favour.

ROADS.

The public roads in Java are extremely good and are constructed most carefully and scientifically.

On tea estates after cleaning the ground a road system is laid out and in doing so a few general principles are followed:—

Roads must never be allowed to act as drains, and indeed must be protected from water by drains on their inner sides. Any water which may collect on a road or the drain along side it must be removed by suitable drains across the road leading into a contour or a main drain lower down the slope. The road scheme should be laid out before the drainage scheme.

In making roads in hilly districts, a slight gradient is given everywhere so that water shall not lie on them. When roads have a long slope in one direction, cross drains are placed at intervals of 50 to 100 yards. These are bridged over in a suitable manner. Slabs of stones are often used, stone being readily obtainable in many of the Java tea districts. There are not many driving roads on most Java tea estates on account of the undulating character of the ground. The smaller roads on estates are made with an appreciation of the fact that on hilly grounds coolies usually prefer to go either up or down hill by the shortest possible route, however steep and gradient, whereas Europeans choose a longer road to avoid a steep hill. In Darjeeling the smaller roads on gardens are made with no consideration for the coolies' point of view, with the inevitable result that paths are made through tea to the detriment of the bushes. In Java, however, such paths are made when the estates are opened out, and they are known as *troessans*. The smaller garden roads, as distinguished from these paths or *troessans*, should be suitable for a man on horseback to ride along. It is not the invariable custom for planters to ride in Java, but many do ride, and the fact is appreciated that a tired man is not observant, and that the "controlle" is likely to be better if work be inspected properly.

DRAINAGE.

The main drain system—almost without exception fairly steeply sloping ground is under consideration—consists of *hoeft afvoergolen* (main drains), which lead directly down the slopes. It is considered most important in connection with the drainage system to remove as far as possible the excess water which cannot sink into the ground sufficiently rapidly in the event of heavy showers. The soils of Java are very porous, and when slight showers fall the rain sinks rapidly into the ground, but the soil is also very readily washed down by water flowing over the surface of the ground if all the rainwater is not immediately removed when heavy showers fall. This is at once an advantage and a danger of the soil of Java. To prevent this loss by wash, it is considered of primary importance to have an escapement for excess water, and the main drains straight down the slopes serve this purpose best, for they ensure the rapid removal of water at places which are chosen for the purpose, and not at places where the rush of water may do damage.

The most suitable situation for some of these drains are the places where there are natural gullies down the concave folds of the hill sides. Where these gullies are pronounced in character one usually finds either rocky ravines, or rather water-logged patches filled with deep rich soil which has been carried there by wash before the opening up of the land.

The stone ravines can be used as drains to some extent if they can be straightened out: and the gullies which are filled with deep earth, add, when drained, to the area on which tea can be planted. The sides of these drains are protected by growing grass on them, and the rush of water down them is stopped by a series of small dams of bamboo, stone, etc. A certain number of *hoeft afvoergoten* have also to be made at intermediate positions between the gullies. The distance between two *hoeft afvoergoten* should not be more than 100–200 yards.

The collection of the water into these main drains is carried out by means of contour drains called *afvoergoten* and these are usually made with a very slight gradient, the object being merely to catch the water and remove it into the *hoeft afvoergoten.** These afvoergoten are laid out very carefully on Dutch estates in Java, and are flanked on the upper and lower sides by banks or berms on which suitable leguminous plants are grown. Grass, e.g., *Andropogon muricatus*, Retz. are often grown on the sides of the drains themselves. They are cleaned out periodically, for the danger of water breaking through must be carefully avoided here, for it would cause great damage.

TERRACES.

Connected with this system of drainage, is the terracing of steeply sloping ground. There is in Java no such general opinion about the value of terraces as there is about the necessity for contour planting, but it is a fact that most steeply sloping ground is terraced, and more gradual slopes are protected by the above described system of contour drains, by hedges of suitable plants, and by catch trenches.

Opinions differ also as to whether terraces should be made before the tea is planted or afterwards. The argument in favour of making the terraces before planting the tea is that the work can then be done carefully and completely without any disturbing factors, and, being done, is done once for all, and when the tea is eventually planted it merely remains to adopt an efficient system of keeping terraces in order. Those who are in favour of making the terraces after planting out the tea base their argument on the fact that in such cases the tea is planted in surface and not in subsoil, and that if at the time of weeding the weeds are regularly placed between the rows of tea, terraces form of themselves and are in all respects as efficient as those made more expensively before the planting out of the tea. It is possible, however, to make terraces, before the tea is planted out, in such a way that the seedling plants are put into surface soil.

Terraces having been made the upkeep of them is a matter of great importance. In Java, many different plants are used to protect the edges of terraces, and these are either planted there directly or, if of naturally occurring species, are encouraged to grow in preference to other plants by a process of selective weeding of the terrace faces.

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*Pits are usually dug at convenient distances apart along these contour drains to prevent the run off acquiring a velocity which might be dangerous to the *afvoergote* or to its *hoeft afvoergote.*

On fairly broad terraces catch trenches (*fangheulen*) are often dug at intervals along the inner edge of each terrace, and these serve to catch the wash which comes from the terrace above. When at intervals these catch trenches are cleaned out, the earth which has collected in them is thrown up on to the terrace above. This method is an excellent one under Java conditions where weeding and forking, instead of hoeing, is the method of cultivation, and it is employed largely both on terraced land and also in cases where the land is not steep enough to terrace. The system generally adopted in the latter case is one of alternate contour lines of catch trenches and green crop, sometimes with one and sometimes with two lines of tea between them. In such cases the positions of the catch trenches—which are about twelve feet long by one foot broad by one and a half feet deep, and have twelve feet intervals along the contours—alternate with those next above or below along different contours, so that if any earth is carried beyond one line, between the catch trenches and past the hedge, it will eventually be caught in the next catch trench below. When these catch trenches are cleaned out, which is usually done at the time of weeding, the earth is thrown up the slope. —IND. TEA ASSOCN. REP.: TEA INDUSTRY OF JAVA & SUMATRA, No. 2, 1916.

IRRIGATION AT ANURADHAPURA.

Some 10 acres are now put into perfect working order for garden irrigation such as is practised in Egypt and in other countries where intensive cultivation by irrigation is carried out. By this method and with proper attention to rotation of crops, deep cultivation of the soil and manuring, the land need never lie fallow from one year's end to the other and can grow as many as three crops annually. The work entailed in laying out such land is naturally costly in the first place, but once prepared it remains serviceable for all time.

It is necessary to level the whole land as much as possible at first. Drains in the lowest parts and field canals in the higher must then be laid out, the canals requiring great judgment to conduct them to the higher land, crossing drains by means of troughs.

The fields themselves must then be laid out in small squares, properly levelled, with strong banks and water feeding channels to each plot thus insuring equality in watering.

Such perfect *asweddumising* is of course only necessary where such crops as tobacco, grain, sugarcane, legumes, vegetables, etc. are to be grown. For such crops as coconuts, oil-palms, cocoa the land need not be made so perfectly level.

D. S. CORLETT.

THE COMPOSITION OF CASSAVA ROOTS.

An article of some interest, by the Chemist to the Central Experiment Station, Santiago de las Vegas, appears in MODERN CUBA for April 1916. This contains a table of analyses of a large number of varieties of cassava grown in different parts of the world. It is stated that the most important constituents of the cassava roots are the carbohydrates (starch and sugar) and a cyanophoric glucoside, Linamarin. The starch content is shown to vary from as low as 11 per cent. in the poorer sorts to 35 per cent. or more in the best. The hydrocyanic content varies considerably both in amount and distribution in the plant. A few years ago it was believed that there are two distinct species of cassava differentiated by their hydrocyanic acid content, and by certain peculiarities in leaf form whence the names 'bitter cassava' and 'sweet cassava.' It is now generally held that the different sorts of cassava are all varieties of one species.—AGRICULTURAL NEWS.

RICE.

PADDY GROWING ON SALINE SOILS.

The lands on the sea-board are saline in nature, and they extend to very near the sea-shore and the fields near the sea are liable to be flooded with saltish water during certain periods of the year—chiefly in the months of October-November. The variety of paddy selected for being grown in such lands is Vadan Samba, and the plants would be sending forth their ears at the time the fields are flooded with saltish water.

The nursery is prepared under the puddle system on receipt of water in the channels, i.e., about the beginning of July, and sprouted seeds are sown at the rate of 2 to 3 Madras Measures per cent. of seed bed. The seedlings are pulled out when they are about 40 days old and planted about a span or a foot apart (the spacing, of course, depends upon the fertility or otherwise of the soil, planting being sparser in good lands than in poor ones), 4 to 6 seedlings being used in each hole. The lands would have been already got ready, and careful, or small ryots fold cattle or sheep in as large a portion of these lands as possible. As a rule, poor soils receive some manuring. It is considered safer to plant more seedlings together as the salinity of the soil may kill some of them. Saltish water gets into the fields during the flow of the sea in the months of October-November, and when it gets out of the field during the ebb, fresh water from the channels is let into the field and drained off with a view to remedy the bad effects of the salt water. It is said that, on certain occasions, it is not possible to do this operation, the crop then suffers much. Good rains at this stage are considered quite essential in such lands.

The after-cultivation done to the crop is the same as that done to paddy crops in general, viz., weeding. Under favourable conditions the crop is said to yield about 700 to 800 Madras Measures of paddy per acre.—AGRIC. STUDENTS' JOURNAL, MADRAS.

RICE CULTIVATION AT PERADENIYA.

The most important work with which this Department has been connected in the experimental cultivation of paddy has been the introduction, by MR. CORLETT, of the canal and drain system of irrigation. The yield from this plot in the first crop of the year was at the rate of 33 bushels per acre, that from the second crop under the new system was 77 bushels per acre. The total amount of water supplied, including rainfall, was according to rough computation, about 50 inches for a five months' crop, which is at the rate of 2·2 inches per week (23 weeks). In a paper on the "Irrigation of Rice in Ceylon,"* read before the Ceylon Agricultural Society on May 25,

* Vide Vol xliv., p.368, June 1915.—Ed. T.A.

1915, MR. BALFOUR, Director of Irrigation, stated that, according to experiments carried out by him in the North-Central Province, a three months' crop of paddy required in one case 41 inches and in another 47 inches of water, including rain, a mean of 44, which is at the rate of 3·38 inches per week (13 weeks). The amount ordinarily used by the villager is in excess of this, hence the quantity applied at Peradeniya was moderate. The heavy crop was due largely, there is little doubt, to the fact that the water was drained off the land to a depth of 20 inches—the depth of the drain—at frequent intervals, allowing it to become ærated. With stream irrigation the villager never allows the land to dry, but keeps the water running all the time till about a fortnight before harvesting; under the tanks alternate irrigation of fields is necessary, and the land sometimes dries, but only on the surface.

Some instructive data on transplanting rice has accumulated through experiments covering several years, and carried out at Maha-Iluppalama and Peradeniya and by the Agricultural Instructors. The usual village practice is to transplant two or three seedlings in the same hole.

In seven experiments carried out at different parts of the Island from 1907-15 with single seedlings planted 4 to 6 or 6 inches apart, the average yield was at the rate of 54 bushels per acre; and in eleven experiments during 1913-15, with three seedlings at corresponding spacing, the average yield per acre was 62 bushels. These results favour the village practice of putting more than one seedling in each hole. If selection of seed plants were resorted to, as at Peradeniya, single seedlings would probably be found sufficient. At Peradeniya and Maha-Iluppalama single seedlings are put out, but at Peradeniya seed is used only from plants that tiller to at least 12 stalks, the selection being carried on from year to year. In the last transplanted crop at Peradeniya a yield of 77 bushels per acre was obtained from single seedlings from such selected seed, as compared with 35½ bushels per acre from the broadcasted plot. At Maha-Iluppalama we found in regard to spacing little difference in yield for distances varying between 4 and 10 inches. Results of experiments by the Agricultural Society go to show 6 inches as the best spacing to adopt when transplanting paddy seedlings.

Molagusamba rice, introduced by MR. C. DRIEBERG in 1914, is growing very successfully in the Kandy and Chilaw Districts, and is now becoming an established type in Ceylon. It is a fine white rice of a superior table type, giving 15 and 16 measures of rice per bushel of paddy, compared with 12 in the case of most local types. The period of growth is five months in the drier and six in the wetter localities.—ANNUAL REP. AGRIC. DEPT., 1915.

GAULTHERIA FRAGRANTISSIMA.

A bag of dried leaves of this was sent to Peradeniya on 7th July. The leaves were collected at Sita Eliya. A bag of leaves has been sent to the Government Chemist. The above plant is fairly common on the patanas at Sita Eliya and Ambawella, and is chiefly found growing along the banks of streams.—PROGRESS REPT., HAK. BOT. GDNS.

CEYLON AGRICULTURE.

THE KALAWEWA IRRIGATION SCHEME.

(See Frontispiece.)

The Kalawewa scheme is more complicated than most irrigation schemes in the Island, and in order to clearly understand the system and extent of irrigation, it is necessary to recognise the different sources from which the water is issued.

Kalawewa and Kala-Balaluwewa are twin tanks, the first of which (fed by the Dambulla and Mirisgoni oyas) receives the surplus water from the second (fed by the Beligama oya); Kala-Balalu-oya is furnished with one sluice, Kalawewa by 2—distinguished as No. 1 and No. 2.

No. 1, like any ordinary tank sluice, irrigates its own track.

No. 2 feeds the Yoda Ela which extends a distance of about 56 miles and supplies the Anuradhapura tanks. Direct irrigation from the Yoda Ela is effected chiefly along the first 7 miles of its course and to a smaller extent from the 7th to the 16th mile.

In addition to such direct irrigation, the Yoda Ela feeds 70 odd tanks along its course up to within 3 miles of Anuradhapura. In the figures given below under "A" no account is taken of the Anuradhapura tanks which in this report are reckoned to be outside the limits of the Kalawewa scheme.

A.—*Extent and conditions of Irrigation under the Kalawewa Scheme.*

(1) *Lands irrigated by Kala-Balaluwewa Tank.* Water rate Re. 1 by original agreement. 220 acres are at present cultivated and about 90 still available for occupation.

(2) *Kalawewa lands irrigated by No. 2 sluice.* Water rate Re. 1 by original agreement. Rates being paid for 1,172 acres made up of WIJEWARDENE'S Block (1,000) and 172 more including RATWATTE'S Land and TAMIL Settlement. Practically no more land is available.

(3) *Kalawewa lands irrigated through Yoda Ela (No. 1 sluice).*

(*a*) Direct from Yoda Ela (1st to 7th mile)
Water plus labour rate Rs. 2 (Re. 1 for each)

Rates being paid for ...	...	2,241 acres
Between the 7th and 16th mile	..	56 ,,
		2,297 ,,
Available for occupation ...	...	500 ,,
Yet to be surveyed about ...	...	2,000 ,,

(*b*) Land irrigated from minor tanks (70 odd) fed by Yoda Ela along its course (56 miles) between the 7th mile and up to 3 miles of Anuradhapura.

Rates being paid for ...	...	3,165 acres
Ready for occupation (scattered in villages)		650 ,,

There are also a number of village tanks which entirely depend upon rain for their water supply. The cultivators under these pay no rates but are subject to special regulations as regards issue of water and details of cultivation.—EXTRACT FROM A REPORT BY MR. C. DRIEBERG.

MAHAILUPPALAMA EXPERIMENT STATION.

REPORT FOR 1915.

The coconut plots have made satisfactory progress and appear in fine condition. Plot A, consists of 17 acres of 7 year old palms, ploughed and disced on irrigable land not regularly irrigated but occasionally flooded to assist ploughing (and when the palms showed signs of being affected by drought).

Plot B, 6½ acres of 8 year old palms not ploughed or harrowed on unirrigable land, has been kept free from cheddy and jungle growth.

The number of trees per acre for these plots is 72 palms 25 ft. by 25 ft.

CROP RETURNS: PLOTS A & B.

Year	No. of palms.	Nuts picked.	Yield per palm	Yield of copra.
A. 17 acres.				
1913	1224	3389	2·76	611½ lb.
1914	1224	14222	11·61	6558 ,,
1915	1224	21069	17·21	9563 ,,
B. 6½ acres.				
1913	449	253	·56	25½ ,,
1914	449	1229	2·73	527 ,,
1915	449	1829	4·07	828 ,,

Actual bearing palms showed an average of 415 palms in Plot A or 21,066 nuts; and an average of 43 palms in Plot B or 1,829 nuts for the year 1915.

Calculating from the yields for the year 1915, the number of nuts required to produce a candy (560 lb.) of copra has been in the case of Plot A, 1,232 and in the case of Plot B, 1,248 with an average of 1,234 from the combined plots.

The copra was well reported upon by Colombo brokers and fetched top prices at the sales in December 1915, namely, Rs. 84·25 per candy.

A new plot of about 2 acres of previously cleared, irrigable land, including the plot of Hevea rubber which, as it is making no growth will be cut out, was planted out in October with year-old palms from the nursery, in holes 30 ft. by 30 ft. (48 palms per acre). In half of this plot the holes were dynamited to watch the effect.

Another plot of 1 acre has also been planted up in palms 30 ft. by 30 ft. The young palms have been manured with cattle-manure and ashes dug in round, and have been kept irrigated by channels and free from weeds in a six foot circle.

A patch of sickly, yellow-leafed palms growing in poor sandy soil in plot A have been manured with an application of old guano and cotton-seed dug in round the palms.

Elephants have broken in several times and uprooted and damaged several young palms.

Both the black and red palm beetles are prevalent, but have been kept in check by constant vigilance and capture.

The citrus trees have been well forked and manured with cattle manure and mulched and show a healthy growth, bearing good crops.

Owing to retrenchments the paddy experiments could not be carried out this year and the fields are lying fallow.

The paddy sown in November in 3, one-acre plots of Suduvi, Molagusamba and Vadansamba at the rate of only $\frac{3}{4}$ of a bushel per acre broad-cast, resulted in a failure, as the crops ripening late became infested with paddy bug. Seventeen bushels only were harvested from the 3 acres,

RAINFALL AT MAHAILUPPALAMA FOR 1915.

Month	Inches	Days	Month	Inches	Days
January -	6·12	13	July -	·28	4
February -	2·29	2	August -	2·25	3
March -	1·24	3	September -	1·19	3
April -	9·36	15	October -	6·23	9
May -	·13	2	November -	15·56	19
June -	1·52	5	December -	5·92	9
Total -	20·66	40	Total -	31·43	47

DUDLEY S. CORLETT,
Acting Manager.

Experiment Station, Mahailuppalama.

SWEET POTATO.

The following table shows the results of the crop harvested on 14th May, 1916. No manure was used:—

	Area of Plot.	Date planted.	Method of planting.	Date of harvesting	Yield lb.	Rate per acre.
"Cluster" var. ...	37 sq. ft.	15 10 15	6" × 6"	4 5 16	10	105 cwt.
Purple-leaved ...	do	do	do	do	16	168 ,,
Cordate-leaved ...	do	do	do	do	38	399 ,,
Hastate-leaved ...	do	do	do	do	26	273 ,,

—HAKGALA PROGRESS REPT., APRIL-JUNE, 1916.

REPORT OF THE MANAGER OF THE EXPERIMENT STATION, PERADENIYA.

TREATMENT OF YOUNG RUBBER PLANTATIONS.

On the "Hill-top" (11 acres) and "Hill side" (7 acres) plantations, the trees are now two years and six months old and continue to show fine growth. Some of the trees are 21 feet high with a girth of 10 inches, 3 feet from the ground. Those planted on the hill 20 ft. by 20 ft. average, girth 5·78 inches and height of 16·83 ft. while those planted in avenues 40 ft. by 15 ft. by 15 ft. on the flat, show an average girth of 6·95 inches and a height of 19·4 ft., but here the soil is considerably better than on the stony hill-side.

The *Tephrosia candida* has been cut 11 times since sowing in December 1913, and five times during the year under review. In February and August the trees were lightly forked round before the mulch was laid on.

Poria hypobrunnea has attacked the *Tephrosia candida* killing out patches and has also killed out a few rubber trees.

Plots 14 and 15, 3½ year old trees from No. 2 tree, Henaratgoda, have been forked round and kept mulched with *Indigofera arrecta*, intersown.

Plot 77 dynamite-hole-blasting experiment, shows only a slight difference in growth to those planted in hand-dug holes.

60 trees 3 years old in dynamited holes, average 23·58 feet in height and 8·96 inches in girth, 56 trees in hand-dug holes average height 20·8 feet and girth 8·63 inches.

Plots 73-76, avenues 40 ft. by 15 ft. by 15 ft., now 2½ years old have been kept disced during the dry weather and have been twice forked round the trees and *Crotalaria striata* mulched. Cow-peas have now been thickly intersown for ploughing in. Average height 16½ feet and girth 6·38 inches.

Plots 11, 12 and 13 (3 acres) were cleared of *Manihot dichotoma* in May, the trees burnt and the land ploughed and disced; and drains dug. Planted in June in hand-dug holes 25 ft. by 25 ft. from 2 year old stumps raised at Henaratgoda from No. 2 tree, *Tephrosia candida* intersown.

After planting, the season proved a dry one and a large percentage died, in spite of mulching. In August 70 and in November 50 supplies were required.

SEED SELECTION PLOTS.

Plot 140 A, 33 ft. by 33 ft., from a small-leaved variety at Henaratgoda. Trees now a year and a half old. Trees have been forked and mulched with *Tephrosia candida* and dadap.

Plot 140 B, 33 ft. by 33 ft., from a black-seeded variety at Henaratgoda. Trees now 2½ years old. Forked and mulched with *Crotalaria*, *Tephrosia candida* and *Leucæna glauca*.

Plot 140 C, 33 ft. by 33 ft., from seed from the old Peradeniya trees. Trees now 2½ years old. Ploughed, trees forked round and mulched with grass and 'cheddy.'

COCOA.

In May the dadaps in all plots were severely lopped in order, firstly, to reduce their height so that lopping them in future will not be so costly and so difficult, and, secondly, to reduce the shade during the wet months.

In September the dadaps were again lopped so that the plots have received two mulchings of green dadap-leaf and the shade again almost entirely taken away for the main crop during the wet, autumn months.

Pod-fungus showed a remarkable decrease over last year. Pickings have continued fortnightly. In plot 1, for October and November 1914, there were respectively 50 and 470 (total 520) fungus pods, and in 1915, 132 and 122 (total 254). In plot 2, for October and November 86 and 900 (total 986) in 1914, and 144 and 40 (total 184) in 1915. The rainfall for October and November 1914 was, respectively, 11·87 inches and 7·41 inches and for 1915 5·88 inches and 12·21 inches. It will be noticed that as regards amount of rain the months changed places in 1915. In 1914 there was heavy rain in October and less fungus-pod and in November less rain and more fungus. This is as it should be as the fungus, engendered by the wet October, would manifest itself the following month. But in 1915 the comparatively small rainfall in October resulted in a decrease of fungus-pods in November.

The decrease is, therefore, probably largely due to the dadap shade having being heavily lopped in October, just before the north-east monsoon, and to regular fortnightly pickings preventing the spread of the fungus.

Pickings have been made regularly every fortnight, the husks being buried with lime to prevent the spread of fungns spores.

The following is the result of the crop :—

April 1, 1914, to March 31, 1915, 31,039 lb. dry cocoa from 38 acres of $7\frac{1}{4}$ cwt. per acre. Plot 100 (1 acre) Castor Cake, gave the highest yield, namely, $11\frac{1}{4}$ cwt. dry. This plot was third in order last year. A Bulletin will be shortly issued for the two years up to date.

The canker on the tree stems has been dealt with in another method this year. Instead of the whole affected area being cut down to the wood, the cankered bark has been lightly shaved off and the diseased area rubbed over with blue-stone (copper sulphate). By this treatment it is hoped the fungus will be killed and the wound heal quicker.

Some of the larger vacant patches in the plots caused by the old Caracas trees dying out, have been supplied by basket plants of Forastero.

No manure has been given to the plots this year as it was decided to let the plots run a fourth year without manure and watch the result.

Plots 63–87, eight year old trees, received an application of burnt lime in September as the preliminary to a series of new manuring, pruning, and spraying experiments, to be carried out on those plots.

The portion which was subject to no shade whilst the plants were young and in which the greater number of plants died in consequence, has been supplied up and thoroughly shaded with new dadaps and *T. candida*, which has been cut, mulched and forked in, to the plants to bring them on.

All dadaps have been twice lopped. The crop from these trees though much improved is much below the average for eight year old trees.

In DR. LOCK'S selected cocoa plot, two new rows have been added to replace the coffee which is dying out and the portion of poor soil has had an application of burnt-lime forked in to improve it.

Plots 68-76A of selected varieties in dynamited holes, now one year old, required a large number of supplies, owing to the poor soil of the hill-side. The inter-sown *T. candida* has been left high-pruned in rings round each plant, as shade and wind protection, the remainder being cut down to 1 foot each time. There have been five cuttings mulched to the plants which have been twice forked round.

Those plants requiring it have been thumb-nail-pruned at the height of three feet and so pruned as to leave the three important primaries. It is hoped that the whole plot will show what the result of green-manuring, systematic pruning and judicious shading can produce. At present the best and strongest plants are those growing under the densest shade and well protected from the wind by *T. candida*.

A plot of two new acres has been added, to test wide-spacing and green-manuring. Plot 1, $\frac{1}{2}$ acre; 6 months old basket-plants of Forastero 20 ft. by 20 ft. Dadaps 20 ft. by 20 ft. to be thinned out 40 ft. by 40 ft. *Sesbania aculeata* sown and mulched and *Crotalaria incana* as a second crop. Both made very poor growth.

Plot 2: half the plot basket-plants of Forastero 18 ft. by 18 ft. and half, seed at stake. Dadaps 18 ft. by 18 ft. as permanent shade and *Cajanus indicus* as temporary shade.

Plot 3; basket-plants of Forastero 18 ft. by 18 ft. with dadaps 18 ft. by 18 ft. and divided into four plots of *Cassia hirsuta*, *Indigofera arrecta*, *Crotalaria incana* and a control. All these green-manures have been difficult to establish owing to poor soil and dry weather.

It has been found that cocoa fermented for one day only, if sun dried, gives a fine colour and fetches as high a price in Colombo as cocoa fermented the usual three days. A small lot sold in November for Rs. 54·50 per cwt., which was top market price.

COCONUTS.

This year the 15 plots of old palms under manurial experiments were not manured, but records kept to watch the results. The crop generally was good and the effect of the previous manure was still noticeable. For the first time the proportion of ripe nuts is considerably in excess of the number of immature ones, thus showing a decided improvement.

The variation in the number of nuts required for a candy of copra was very marked.

Plots 11 and 14 manured with Basic Slag and Kainit, and unmanured respectively, required 1,380 nuts per candy, while No. 6, digging and mulching, required 2,100 nuts.

A separate Bulletin will be published, bringing the results of the experiments up to date.

In plots 53-56, 10 acres of nine year old palms, discing has been kept up every alternate month to keep the weeds down and the soil in a friable condition. This treatment has brought the young palms on remarkably well, and some of the palms are bearing heavy crops.

The plantation has been divided up into sixteen plots and a scheme of manuring drawn up. As a preliminary, 7 plots in September received a dressing of 2 tons per acre of burnt lime, which was disced in. Sixty supplies have been planted in holes almost entirely filled in with ashes and surface-soil and not in holes a foot from the surface as before. Three hundred and fifty-four beetles of both the red and black species have been caught by hand during the year.

Groups of four palms each have been selected on the 3 plots not to be manured but disced. The scheme of manuring is as follows:—

Four palms of 8 year old and four palms of 12 year old.

Plot 1.—Nitrogen and Potash only:

Ammonium sulphate	300 lb. per acre	5 lb. per palm
Sulphate of Potash	120 ,, ,,	2 ,, ,,
		7 ,, ,,

Supplying 1 lb. each of Nitrogen and Potash per palm.

Plot 2.—Nitrogen and Phosphoric acid only:

Ammonium sulphate	300 lb. per acre	5 lb. per palm
Ordinary Superphos.	333 ,, ,,	5·6 ,, ,,
		10·6 ,, ,,

Supplying 1 lb. each of Nitrogen and Phosphoric acid per palm.

Plot 3.—Phosphoric Acid and Potash only:

Ordinary Superphos.	333 lb. per acre	5·6 lb. per palm
Sulphate of Potash	120 ,, ,,	2·0 ,, ,,
		7·6 ,, ,,

Supplying 1 lb. each of Phos. acid and Potash per palm.

Plot 4.—Nitrogen, Potash and Phosphoric acid (Basic):

Nitrolim	333 lb. per acre	5·6 lb. per palm
Basic slag	300 ,, ,,	5·0 ,, ,,
Sulphate of Potash	120 ,, ,,	2·0 ,, ,,
	753 ,, ,,	12·6 ,, ,,

Supplying 1 lb. each of Nitrogen, Potash and Phos. acid per palm.

MANURES APPLIED IN MARCH 1915.

This experiment is duplicated on 4 plots of 4 palms each near the head kangany's lines where the palms are under grass.

Nurseries have been laid down with nuts from the big-nut bearing palm from Java, and from the collection of 27 varieties of Ceylon coconuts kindly sent by MUDALIYAR A. E. RAJAPAKSE.

The highest price obtained by auction for nuts was Rs. 46 per 1,000 in the month of February; for copra, sold in Colombo, Rs. 75·50 per candy in March; and for oil by auction Rs. 2·30 per gallon in February.

COFFEE.

The 13-year old Hybrid coffee has been cut down to one foot from the ground, as *Hemileia* and scale which were prevalent on it, might have spread to the newly-planted coffee in adjacent plots. Two shoots were allowed to come up from the stools and these have been carefully pruned to make bushes of good shape. The plot is unshaded and only one stool has died.

The hybrid coffee bushes round the show plots appear to have recovered from their attacks of *Hemileia* and green-scale though both are still present. This is probably due to mulching, manuring and good cultivation. They are bearing very heavy crops, one bush yielding a crop of 11½ lb. of green berry (5¼ lb. dry) at one picking.

They have been divided into two sections, those most resembling the Liberian parent and those of the Arabian. The berries of each will be submitted for the testing of flavour.

In June, 3 new plots of Canephora, Quillon and Uganda (Robusta) were planted out 10 ft. by 10 ft. under dadap shade previously established. The plants were 6 months old and in bamboo pots. The plots were previously in citronella oil-grasses, the rotten roots of which were used to fill the holes. As cora-grass was bad in the plots, sweet potato was sown to smother it out till, in four months, the shade of the dadaps was sufficient to check growth, when the potato-vines were removed and heaped to rot and form a leaf-soil for application to the plants. The dadaps have been so pruned as to form an umbrella shade over the young plants and they will be kept in this form. The loppings were mulched to the plants.

Green scale *(Coccus viridis)* made its appearance, but by introducing the fungus, *Cephalosporium*, the scale has been completely checked.

Half a pound basic slag has been applied to each plant, except those in control rows, to watch the effect.

A small plot of Arabian coffee plants in baskets raised at the Hakgala Gardens was laid out 10 ft. by 10 ft. in October, under established dadap shade.

The six-year-old Robusta-coffee plot appeared in such poor condition that in June manure was applied to form the following experiments :—

1. Nitrogen omitted.
2. Phosphoric acid omitted.
3. Potash omitted.
4. Complete mineral mixture.
5. Complete organic mixture.
6. Control.

The Robusta plot planted in 1914 without shade, and as a result severely attacked by both leaf and scale diseases, has much improved since the dadap shade was planted a year ago. Though both diseases are still present the puny plants have grown strong and appear vigorous and healthy. The plants have been well forked, mulched and ½ lb. basic slag applied to each.

The two-year-old Robusta plot, under *Leucæna glauca*, continues to make a healthy and rapid growth. *Hemileia* is not present, though the plot, when growing Liberian coffee, was very badly affected. But green-scale made its appearance, only to be killed out by introducing the *Cephalosporium* fungus. The primaries were also attacked by die-back.

BASIC SLAG, ½lb. PER TREE, APPLIED IN SEPTEMBER.

The two isolated and unshaded bushes of Uganda (Robusta) coffee by the Office have borne a heavy crop for the first time, yielding 11 and 10 lb., respectively, of green berry at one picking.

TEA.

The plucking has been entirely to the whole leaf, which largely accounts for the satisfactory yields and generally good wood-development in the bushes. The highest yield was from Plot 149 (dadaps), 6,270 lb. green leaf making 1518 lb. made tea per acre per year.

The total crop for the year from the 15 acres, of which 10 acres were pruned in June and July and 4 acres are under rubber, was 42,588 lb. green leaf, equal to 10,275 lb. made tea or 685 lb. made tea per acre. The leaf was made into tea at the New Peradeniya factory, at a cost of 10½ cents per lb., and the average price realised was 48·67 cents per lb.

Plots 141-145 and 151-155 were pruned in June and July and Plots 146-150 were begun in December.

Plots 144 and 145 were supplied with 600 plants of Assam hybrid from Frotoft Estate, Ramboda, but about 50% have died owing to dry weather.

Plots 146-150 were supplied with 800 plants Manipuri indigenous from Kotiyagala Estate, Bogawantalawa. These have made very poor growth.

Plots 141-143 and 154-155 supplied with 600 plants of Assam Hybrid from Kalugala Estate, Pussellawa, 50% appear to have struck.

Owing to pruning operations, the sweet-potato vines put down to smother the cora-grass, had to be taken up before the two years necessary to completely get rid of the pest. In consequence, though the weed is much weakened, it still exists.

TEA MANURING.

These experiments have been continued with satisfactory results.

All pruned plots, 6 weeks after pruning, were manured with 100 lb. basic slag and 60 lb. sulphate of potash per acre in alternate lines lightly forked in with the leaves and the branches laid over.

In Plot 144 the dadaps have been pruned twice, yielding 3,869 lb. 1,484 lb. less than last year. This plot shows an increase in green tea-leaf of 1,490 lb. over last year.

In Plot 149 the dadaps have been pruned twice yielding 3,268 lb., a decrease of 2,379 lb. less than last year. The plot shows an increase in green tea-leaf of 1,162 lb. over last year.

In Plot 150, the old albizzias were cut once yielding 2,357 lb. a decrease of 716 lb. The increase of green-leaf was 691 lb.

The plots receiving no green-manure treatment, show a slight falling off in yield and also in wood development.

All the tea, Plots 141-155, ran two years between prunings and showed little sign of exhaustion even at that period, except on some of the untreated plots.

Further manurial experiments will be carried out.

CROP RETURNS.

		1914.	1915.	Acreage.	Yield per acre 1915.
Tea (green leaf)	lb.	56,415	42,588	15	685 (made tea)
Rubber	,,	—	1,541¾	—	—
Cocoa (April 1914 to March 1915)	,,	21,726	31,039¼	38	7¼ cwt per acre
Coconuts	No.	103,899	96,820	34	2,848 per acre
Coconut oil	Gallons	205½	207	—	—
Coconut poonac	lb.	1,827	1,300	—	—
Copra	,,	9,958½	10,786½	—	—
Coffee	,,	528½	553½	—	—

PADDY.

The crop of DR. LOCK's selected paddy, planted by a village cultivator in November 1914, was harvested on the 20th April. The plants were transplanted 6 in. by 6 in.

The yield was as follows:—

Upper marshy half of 1½ acres ... ... 40½ bushels.
Lower drier half of 1½ ,, ... 58¾ ,,

Total 99¼ bushels or an average of 33 bushels per acre, an increase of 2 bushels over the previous Maha crop.

Seed from the best plants, bearing good heads and 12—15 stalks from one stool, were selected and preserved as seed for the following crop.

The field was then prepared for the next crop by reorganising the water supply. Two small field-canals were made on either side and a deep drain cut down the centre of the fields. By this means the water can be controlled and evenly distributed over the fields at a depth of 2 inches only. The drain was successful in draining the soil and rendering the fields sufficiently dry to be ploughed by an English plough and bulls, and sun and air allowed to sweeten the soil.

On August 23rd 1½ acres were sown broadcast (1 bushel per acre) with LOCK's selected seed, after the fields had been prepared in the ordinary village manner, save that a large land-leveller drawn by cattle was employed to render the fields perfectly level and prepare a good, deep seed-bed.

The remaining 1½ acres was transplanted 6 in. by 6 in. on September 6th with six-weeks old plants from the prepared nursery.

The whole crop is showing a very fine and sturdy growth and stooling remarkably well. The transplanted portion shows a marked, finer growth than the broadcasted.

Two small plots of Hondarawala or Hill paddy were sown broadcast on 6th September and one small plot of Philippine paddy on October 7th.

EGYPTIAN CLOVER.

Special seed of this clover or *Bersim* was obtained from Egypt and sown under the most favourable conditions in the paddy fields but without any success.

SUDAN DURA.

The red variety of Dura, picked from the other varieties because of its not being so susceptible to wet-weather and the attacks of birds, was harvested in 115 days from sowing. The crop was a good one and made a fine show when ripening with its rich, red colour. A pink variety was selected from the crop as possessing the advantage of threshing out more freely from the glumes.

The whole of the red dura as well as 25 bushels of the other varieties grown here and at Anuradhapura, has been distributed to the Government Agents of the Northern, North-Central, Eastern, Uva and Central Provinces as well as to the Agricultural Society for free distribution to the chena and village cultivators.

MANILA HEMP.

The plants received from the Philippines in August 1914 are now 12 feet high and producing quantities of suckers for distribution.

VANILA.

The vines are gradually being transferred from the dadaps to the Plumeria shrubs, now thoroughly established and forming good, light shade. The vines have been kept well mulched with dadap loppings and jungle growth and are making vigorous growth.

They have flowered both in the Spring and Autumn.

ECONOMIC PLOTS.

Owing to retrenchments, only one acre of these proposed ten acres has been laid out, these being in fibre, oil products and sugar cane.

Fibres:—

Sanseviera zeylanica	...	...	Bow string hemp.
Furcræa gigantea	...	...	Mauritius hemp.
Agave sisalana	...	...	Sisal hemp.
Crotalaria juncea	...	...	Sunn hemp.
Corchorus capsularis	...	...	Jute.
Bœhmeria nivea	...	...	Ramie.
Phormium tenax	...	...	New Zealand flax.
Musa textilis	...	...	Manila hemp.

Cottons:—

Sea Island.
Allan's Long Staple.
Durang.
Cambodia.

Oil products:—

Croton tiglium	...	...	Croton-oil.
Ricinus communis	...	...	Castor-oil.
Jatropha curcas	...	...	Physic nut.
Helianthus annuus	...	...	Giant Russian sun-flower.
Sesamum indicum	...	...	Gingelly.

Essential oil grasses:—

Andropogon Nardus.
Cymbopogon polyneuros.
Andropogon citratus.
Cymbopogon Martini.

Ground-nuts:—

Arachis hypogœa, Ceylon
Virginia Runner
Spanish bunch
Mauritius.

The jute was small in growth and the New Zealand flax is slow in establishing itself.

The ground-nuts yielded as follows :—

	Yield per acre bushels.	Weight per bushel lb.	Percentage of oil.	Cost. Rs.	Cost. c.	Value. Rs.	Value. c.	Profit per acre. Rs.	Profit per acre. c.
Spanish Peanuts	21	17½	47·2	16	40	39	00	22	60
Virginia Bunch	12·6	24	43·6	9	80	31	50	21	70
Ceylon Variety	68	24	49·6	53	00	170	00	117	00

It will be seen the Ceylon variety contains the most oil and yields the greatest profit per acre.

The remaining nine acre plots have been kept in cultivation by sowing Dura and legumens ploughed in green to improve the soil.

FRUIT AND VEGETABLE PLOTS.

The grafted mangoes treated with legumes, dug in round the trees and a little basic slag are making good growth.

Two plots of citrus, one of limes and lemons, and the other of oranges, have been subjected to the following experiment :—Each row consists of 6 two-year old plants.

First row Nitrogen omitted.
Second ,, Phosphoric acid omitted.
Third ,, Potash omitted.
Fourth ,, Complete Mineral mixture.
Fifth ,, ,, Organic mixture.
Sixth ,, Control.

The limes have had two crops of ground-nut vines dug in in trenches and the oranges, leguminous crops of cow-pea dug in.

In the limes one tree has borne fruit in its second year and is heavily in blossom.

The mangosteens make very slow growth although planted under shade.

The sapodillas are at last making a strong growth after being freed from the brown-scale attacking them and being well manured and mulched.

The lemon trees are bearing heavy crops although the lemons do not turn a golden colour when ripe but remain a yellow green.

The cherimoya tree makes slow growth and is being shaded.

Four tree-tomatoes (*Cyphomandra betacea*) from Nuwara Eliya have been planted under shade and are making strong growth although not suited to this elevation.

The Granadilla Vine (Passion Fruit) has made a wonderful growth and borne a big crop of large fruits. All flowers are fertilised by hand on opening.

Grafting and budding of citrons has again been unsuccessful.

A selection of native and European vegetables has been raised.

Phaseolus lunatus, a climbing bean, has produced very heavy crops of white beans resembling the dried haricot-beans largely sold as an important food-stuff. The price has risen from 25 cents to 31 cents and there is no reason why this profitable bean cannot be largely grown by the village cultivator, as a single vine will yield over a pound of dried beans.

BANANAS.

The plantain fungus, *Fusarium*, has continued to attack all varieties and even the hitherto immune variety Hondarawala, in spite of constant cutting down of diseased plants and leaves and burning them.

The plants are now yielding their third generation from planting in June 1913, and results will be published next year.

SHOW PLOTS.

These plots have been kept up with varieties of green-manures. *Cassia hirsuta* and *Sesbania Egyptiaca*, sown from second generation have greatly degenerated. Added to the collection are *Indigofera hirsuta*—a strong growing plant yielding a dense crop of leaves for mulching purposes—and *Cassia mimosoides*.

Ajowan, an important drug, has been introduced and seeded well.

NEW WORKS.

Though new buildings are needed and the old ones need repairs and alterations, it has been impossible to do anything this year except replace with iron the thatched roof of one of the cooly lines which was destroyed by fire.

VISITORS.

Naturally owing to the war there has been a great falling off of visitors save in local planters.

His Excellency SIR ROBERT CHALMERS paid a visit on 21st February.

Early in the year the Right HON. SIR WEST RIDGEWAY, late Governor of Ceylon, and MR. AYLMER PEARSON, Governor of British North Borneo, visited the station. It was SIR WEST RIDGEWAY who was mainly instrumental in securing the Station in 1902 for the Department. He expressed his pleasure at its progress.

D. S. CORLETT,

Manager, Experiment Station,
Peradeniya.

HAKGALA FLOWER GARDEN.

There was a good show of annuals during April and May, the following doing especially well: Antirrhinums, Phlox Drummondii, Schizanthus, Linaria, Ageratum etc. Several of the smaller beds were replanted towards the end of May, but the plants were damaged by the wind early in June.

THE GREENHOUSE.

Gloxinias and Streptocarpus hybrids have done very well. On one plant of the latter 13 flowers were out at once and on a plant of the former 15 flowers were produced. The following Orchids were in flower during May:- Cypripedium insigne, C. callosum, C. sedeni, C. insigne var., and a few varieties of Vanda and Cœlogyne. The condition of the Orchids has greatly improved since the staging was erected in the Orchid house and the house devoted solely to Orchids.—PROGRESS REPT., APRIL-JUNE, 1916.

PROGRESS REPORT OF THE EXPERIMENT STATION, MAHAILUPPALAMA.

From 15th April to 15th June, 1916.

COCONUTS.

The second picking was done in May, 1916. The number of nuts collected was 5,210 from 671 palms, an average of 7·76 nuts per bearing palm or 3·11 per acre palm.

Of this quantity, in the irrigable area (8 year-old palms) consisting of 1,224 palms, 609 bearing palms gave 5,475 nuts, an average of 8·99 per palm or 4·47 per acre palm.

In the un-irrigable area (9 year old palms) consisting of 449 palms 62 bearing palms gave 455 nuts an average of 7·33 per bearing palm or 1·09 per acre palm.

The following figures have been obtained with regard to copra production.

COMBINED PLOTS.

Month.	*Break nuts.*	*Rejtns:*	*Copra produced.*	*No. of nuts per candy.*
March	1,336	1 %	512 lb.	1,447
		Plot A.		
March	1,181	1 %	449 lb.	1,457
		Plot B.		
March	155	—	63 lb.	1,377

A consignment of copra was sent to Colombo and sold 9th May, 1916 fetching Rs. 66 per candy.

GENERAL WORK.

Ploughing and discing of the older plots has been continued and weeding round the young palms.

D. S. CORLETT,
Acting Manager,
Experiment Station, Mahailuppalama.

HICKORY KING MAIZE.

The following table shows the results of the crop harvested during the first week in June:—

Area of plot.	Date of sowing.	Method of sowing.	Manure used.	Date of harvesting.	Yield.	Rate per acre.
1,008 sq. ft.	3'12'15	12 in. apart each way.	Farmyard.	June 1st & 7th 1916.	36 lb.	1,540 lb.

The cobs were ripening when the winds started and the next crop will be sown a month earlier. The average height of the plants was 9 ft.—

PROGRESS REPT., HAK. BOT. GDNS.

PROGRESS REPORT OF THE DRY ZONE EXPERIMENT STATION, ANURADHAPURA.

From 15th April to 15th June, 1916.

TOBACCO.

All the tobacco has been air cured and baled and sent to MR. SCHERFFIUS at Jaffna for final treatment.

CEREALS.

The red Dura grown from selected seed has been harvested in 3 months sown on 8th March and harvested 2nd June, 1916. The heads were remarkably fine and the grain large and easily threshed. Owing to the unusual rain throughout the crops irrigation was not required. The crop in no way suffered by mould from the wet nor were any diseases found such as smut or stem-borer.

Parrots made determined attacks on the crop and growers must take the precaution of establishing birds scarers or boys beating tins during the early morning and evening during the three weeks of seeding otherwise much of the crop will be lost. This does not entail much extra labour. Plots have been resown under irrigation as there is still time before the monsoon to grow and reap another crop.

These crops can therefore be grown in a year provided the land is alternated with a leguminous crop, one plot having a light dressing of lime (4 cwt. per acre) and the other none.

The limed plot shows double the growth and the plants are vigorous.

Closer sowing i.e. rows 8 in. apart has been followed this time and the plants thinned out to two inches; one foot apart for rows seemed a little too wide.

Encouraging reports have been received from the Assistant Government Agent, Mullaitivu, Northern Province, showing that the people are beginning to appreciate this grain as a food and as a useful crop to cultivate.

The millet did well in the maritime pattus in spite of the abnormal drought experienced this year. The people grind the seeds into flour and make "puttu" from it and find it very relishing. They have seeds for sowing on a larger scale next year.

The plants did well when sown on high lands by the Sinhalese villagers, but were damaged by birds.

TEA.

Tea seeds of Assam Hybrid Jat from Horagalla Estate, Dolosbage, and Manipuri Indigenous Jat from Syston Estate, Ukuwela, have been received free of charge for experimental purposes. A small portion of each has been placed in watered sand, to plant out in the shaded plots as soon as they germinate. The remainder has been sown in nurseries 4 in. by 4 in. to determine the possibility of establishing tea nurseries in the Dry Zone, isolated from any chance of infestation from Shot-hole borer.

COCONUTS.

Four new acres have been stumped, ploughed and levelled ready for the coconuts.

IRRIGATION.

Owing to the fact that the present plots under cultivation are on the higher level and that no proper regulators exist in the canal, a good deal of difficulty is experienced each week in irrigating the 40 plots under crops of all kinds. It is necessary that each small plot be perfectly level and possess good banks and the work of laying out the small field canals over undulating land requires much skill to carry the water over low portions and drains to reach the higher portions. Also the coolies are untrained in the art of utilising the water quickly and judiciously and allowing none to waste.

Drains have all been deepened and carried out to a main drain which will eventually empty itself in the small river.

LABOUR.

Labour from Jaffna and Batticaloa is plentiful.

D. S. CORLETT,
Acting Manager, Dry Zone Experiment Station.

PROGRESS REPORT, PERADENIYA EXPERIMENT STATION.

(From April 15 to June 15, 1916.)

TEA.

1. The yield for the month of April was 5,011 lb. green leaf from 10 acres. For May 5,232 lb.

2. February and March's made tea fetched 53 cents for Broken Orange Pekoe and an average of 47·50 cents and in April 57 cents and an average of 47·43.

3. Plots 146–50 were tipped in April and are now in full flush.

4. Plot 144; dadaps, were lopped in June and yielded 5,183 lb. green mulch.

Plot 149; dadaps were lopped and yielded 6,920 lb.

Plot 150; albizzias were lopped and yielded 8,540 lb.

5. Tea seed has been placed on a bed of sand and covered with sand and wet sacks to hasten germination when they will be planted out at stake to fill up vacancies in the old plots where constantly renewed tea-stumps have failed to grow.

RUBBER.

6. *Tephrosia candida* has been cut and mulched for the fourteenth time since planting in 1913.

7. Plots 73–76 (planted in avenues) has been interplanted with *Leucaena glauca* previously placed in boiling water and allowed to soak. The germination is good and such treatment is necessary for these hard seeds.

8. Plots 11-13 have had 50 supplies of 2½ year old stumps from No. 2 tree Heneratgoda.

9. Plots 14 and 15 four year old from No. 2 tree (planted 20 × 15 ft.) has been thinned out by selection by MR. PETCH. The smaller trees have been utilised to supply vacancies in other plots.

COCOA.

10. All dadaps have been severely lopped to again reduce their height and density. This work has been considerably handicapped by rain and scarcity of men able to climb such high trees.

11. Two small rounds of pickings have been completed.

12. Tundu B (¾ acre) Porto Cabello variety and the small plots round the tea containing special varieties have had the following general mixture applied:—

Nitrolim ...	39 lb.	Kainit ...	150 lb.
Sodium Nitrate ...	38 ,,	Sulph. of Potash ...	9 ,,
Basic slag ..	64 ,,	at 2 lb. per tree	

COCONUTS.

13. The ten acre plot of nine year old coconuts has been ploughed and disced.

COFFEE.

14. The dadap shade over all plots has been lopped to shape them on the same principle as those in the tea.

15. All vacancies of the various varieties have been supplied.

16. The small plot of old Hybrid coffee trees that was cut down and allowed to renew two shoots per stool has been manured with the following general mixture:—

Bloodmeal ...	21 lb.	Basic slag ...	50 lb.
Castor Cake ...	6 ,,	Kainit ..	100 ,,
Groundnut cake ...	6 ,,	Sodium Nitrate ...	56 ,,
Bone meal ...	59 ,,		

These plants are now in bearing. After having been cut down in December, 1915, they blossomed in March, 1916. They are being kept well pruned. These plants were supposed to be immune from disease but though before cutting down both *Hemileia* and green-scale were present to a slight degree, they did no apparent damage. Now, however, the leaf disease *Hemileia* has severely attacked the plants which are being sprayed with Bordeaux Mixture and Resin-soda mixture combined. Green scale is also present.

17. The papaw plot behind the Store has been planted with dadap cuttings 10 ft. × 10 ft. for Macrocarpa coffee.

PADDY.

18. The one acre above the road of marshy soil, has been ploughed and carefully levelled and sown in Heeneti paddy for the *Yala* crop. Broadcast at one bushel per acre.

19. The remaining 2 acres below the road have had the leguminous crops ploughed in and, after one month, disced and resown with various green manures for the *Maha* crop.

20. *Extract of letter from* MR. C. E. G. PANDITTESEKERA *to the Director of Agriculture.*

"With the aid of MR. MOLEGODE of the Agricultural Society I experimented on paddy transplanting at Madampe fields and the returns were very satisfactory.

In the transplanted plot stalks grew up to 76 inches while the stalks of the broadcasted paddy reached only 40 inches. The yield on 8 measures of transplanted was 396 measures against 36 from the broadcasted.

I expect to do some more transplanting, etc., this year too with the aid of your Society."

DURA.

21. Two plots were sown on 11th May.

(See Anuradhapura Report.)

PAPAWS.

22. This half-acre plot planted 6 ft. × 6 ft. in June, 1914, with a ground cover of sweet-potato as cora-grass and weed smotherer, has been tapped for papain from February to October, 1915, in the following methods:—

	No. of trees	No. of tapings	No. of fruits tapped per month	Total weight of dry papain grms	Average yield per tree oz	Yield per acre 1,210 trees
Long papaw trees tapped every eighth day ...	12	34	1460	729·95	2·08	157 lb.
Round papaw trees tapped every eighth day ...	12	34	1126	726·0	2·08	157 ,,
Long papaw trees tapped every fifth day ...	12	52	1682	789·9	2·25	170 ,,
Long papaw trees tapped once a week ...	12	35	1003	495·5	1·41	106 ,,
Papaw trees tapped every tenth day ...	204	67	7781	5689·15	3·88	292 ,,

It will be seen that there is no difference in yield of latex between the round and elongated fruits and that the yield per tree tapping in periods of from 5 to 8 days is small, for the nine months. But in the second experiment of tapping 204 trees of all kinds every 10 days for seven months yielded nearly a quarter of a pound per tree—a very good average.

In spite of the latex not having been well cured it sold for Rs. 3·50 per lb.—good white papain being worth in Colombo Rs. 4 to Rs. 5 per lb.

SHOW PLOTS.

23. These have all been resown with various green manures including the following new varieties brought from Java by MR. BAMBER:—

Tephrosia vogelii
Tephrosia villosa
Cassia tora
Crotalaria alata
Crotalaria mui jussi
Indigofera longæracemosa
Indigofera suffruticosa

LABOUR.

24. Uusally in May and June extra labour is brought in from the local villages to cope with the extra work during the monsoon, but this year owing to the unusual amount of sickness in the villages following the severe drought this has not been possible even with offering 50 cents per day. Endeavours were made to obtain Jaffna Tamils but only a few were with great difficulty brought up.

Consequently work has got behindhand and weeds are very troublesome. Efforts are being made to obtain a larger permanent Tamil labour force.

DUDLEY S. CORLETT,
Manager, Experiment Station, Peradeniya.

AGRICULTURAL STATISTICS OF BRITISH INDIA.

CLASSIFICATION OF CULTIVATED AREA OF 1914 1915.

Area by professional survey	619,311,000
,, under forest	82,935,000
,, not available for cultivation ...	145,427,000
Culturable waste other than fallow ...	115,080,000
Fallow land	45,897,000
Net area cropped	227,611,000
Irrigated area	47,194,000
AREA UNDER FOOD CROPS.	
Rice	77,699,000
Wheat	25,451,000
Barley	7,905,000
Jawar	21,223,000
Bajra	16,042,000
Raji	4,251,000
Maize	6,188,000
Gram	14,364,000
Other food grains and pulses	31,412,000
Total food grains	204,535,000
Sugar	2,459,000
Other food crops	8,200,000
Total food crops	215,194,000
AREA UNDER NON-FOOD CROPS.	
Linseed	2,526,000
Sesamum (til or gingelly)	4,478,000
Rape and mustard	4,144,000
Groundnut (c)	2,379,000
Other oil seeds	1,806,000
Total oil seeds	15,333,000
Cotton	15,222,000
Jute	3,309,000
Other fibres	976,000
Indigo	146,000
Opium	179,000
Coffee	87,000
Tea	584,000
Tobacco	1,056,000
Fodder crops	6,363,000
Other non-food crops	1,752,000
Total non-food crops	45,007,000

SOILS AND MANURES.

THE ANALYSIS OF SOILS.

LEONARD J. WILD, M.A., F.G.S.

When the methods of scientific research first began to be applied to the development of agriculture, among the first workers to enter the new field was the chemist; and, in fact, it may be said without fear of contradiction that every discovery of importance up till about forty years ago was the work of a chemist. Thus the names of PRIESTLEY, DAVY, LIEBIG, LAWES and GILBERT, not to mention a host of others, will be for ever associated with the advance of our knowledge of the principles of plant production in the early and middle portions of the nineteenth century; and, so great respect did these men obtain for their profession, that even to this day, notwithstanding the enormous advances in botany, zoology and bacteriology, agricultural chemistry is, in some quarters, held in higher esteem than most other branches of science which have contributed to the progress of agriculture.

So fruitful was the work of the early chemists in discovering the methods of plant nutrition that it was naturally expected that, with refined methods of analysis then coming into use, and with a gradual extension in knowledge of the mineral requirements of plants, the time would soon come when, having analysed a given soil, the chemist would be able to prepare a manurial prescription for it in much the same manner as a doctor prescribes for a sick man. This hope dates back to 1843 to the mineral theory of plant nutrition formulated by LIEBIG, who, in his "Law of the Minimum" states that "by the deficiency or absence of one necessary constituent, all the others being present, the soil is rendered barren for all those crops to the life of which that one constituent is indispensable." The idea so born proved a precocious offspring, and, fostered by chemists who had at tl eir command improved methods of soil analysis, it developed through lusty youth, and reached its full vigour during the last decade of last century. However, owing to the frequent deceits which it practised on its friends and supporters, its popularity languished, and finally, being spurned by its former adherents, it seeks to impose its spurious promises on the unsuspecting layman; and as this old deceiver is abroad in this country, it is thought that the time is opportune to force him into public, and compel him to show his credentials. In short, and to drop the metaphor, farmers are still encouraged to send in soils for analysis and report, and as many voluntarily send them to this institution the present article is an attempt to explain to those interested that such procedure has lost the support of scientific argument, and is to be discouraged except within certain limitations to be mentioned later.

The arguments expressing the false idea that the analysis of soils is the immediate and infallible solution of all problems of fertility may be set out shortly in the following statements:—(1) Chemical analysis shows that plants are composed of certain elements, among the most important of which are carbon, nitrogen, lime, potash, and phosphoric acid. (2) The combined work

of chemists and botanists proves that carbon is secured almost entirely by the leaves from the air, and that of the other four constituents nitrogen is, in most cases, and lime, potash and phosphoric acid are, in all cases, got from the soil. (3) By analysing any given soil we shall discover which of these essentials it is deficient in, and consequently what kind of fertiliser will be necessary to produce maximum crop returns. Of course, no one with any knowledge of the developments of the last twenty years would set out the case in this crude form, yet the writer, being requested by farmers to give the results of their soil analysis, and asking why such was desired, has often had the above proposition submitted to him in almost the identical form in which it is here expressed.

In order to expose the fallacy, it is only necessary to state the case in quantitative terms, and by giving it enough rope, so to speak, allow it to strangle itself. The following table shows in lb. the quantities of the various constituents removed per acre by the crops specified:—

Quantities of Certain Constituents removed per acre by crops:

Crop.	Nitrogen.	Potash.	Phos. acid.	Lime.
Wheat, 40 Bushels ...	66	38	28	12
Oats, 45 Bushels ...	52	46	19	11
Swedes, 14 Tons ...	98	80	22	42

Now let us assume that, in collecting these materials, the plants draw from only the top six inches of soil, and that a cubic foot of soil weighs 70 lb. Both assumptions are, of course, well within the mark in most cases, but even this allows us over 1,500,000 lb. of soil. Further, in order to see what chemical analysis can tell us about the amounts of these constituents contained in Canterbury soils, we may take the following figures, which are the highest and the lowest recorded under each heading in a list of analyses of 65 soils from this province, and for convenience of comparison, let us convert the percentages into lb. per acre:—

	Nitrogen.		Potash.		Phosphoric acid.		Lime *	
	%	lb. per acre.	%	lb. per acre.	%	lb. per acre.	%	lb. per acre.
Highest ...	·37	5,550	·54	8,100	·31	4,650	·88	13,200
Lowest ...	·058†	870†	·18	2,700	·10	1,500	·15	2,250

When we now compare the demands of the various crops with the supplies in the soil it is evident that we are very far from a solution of the fertility problem. It is true that the one set of values is much below the other set-but even the lesser figures are greatly in excess of requirements. The poorest soil in Canterbury of which a record is available, is shown to contain 1,500 lb. of phosphoric acid, and yet who will deny the benefit to turnips of an application of even 1 cwt. of superphosphate, which contains less than 20 lb. of phosphoric acid?

* It should be remembered that lime serves other functions in the soil besides supplying plant food.

† An exceptionally low value for New Zealand soils.

Considerations of this sort quickly showed that a soil analysis cannot be interpreted so simply for the benefit of the farmer, and forced the conclusion that the soil compounds containing the elements required by crops are of a more complex character than the ordinary fertiliser substances, and only slowly come into the soluble form demanded by the plant. To put it shortly, the chemist showed the quantities of potential plant food in the soil, but he could not show the quantities that the plant could get out. To meet this difficulty many suggestions wery brought forward, of which the following two classes are the more important:—(1) It was sought to determine factors expressing the proportion immediately available to the plant of the total minerals dissolved by strong acids, on the assumption that the amount abstracted by a crop bears some constant ratio to the total quantity. But there was no evidence of such a constant ratio even for a single crop on a given soil, still less for different crops on different soils, and thus the factors chosen were quite arbitrary selections, and, having little or no experimental verification, were soon found to be unreliable, if not altogether useless. (2) A more promising suggestion was the use of dilute acids, such as acetic acid, in place of the strong ones hitherto employed, but the first workers along such lines seemed to have no very definite reasons for their particular choice; in other words, selection was still arbitrary, and the results obtained by such analyses gave no more reliable indications of relative fertility than those by previous methods.

However, in 1894, an epoch-making event occurred in the publication by DR. BERNARD DYER in the JOURNAL OF THE CHEMICAL SOCIETY of a paper embodying the results of a most careful investigation of the relative fertility of some soils from the Rothamsted Experiment Station. After much preliminary work DYER adopted as solvent a one per cent. solution of citric acid, the ground for his choice being: first, that previous work by STUTZER had shown a satisfactory correspondence between the solubility of fertilisers in weak citric acid and their known manurial efficacy; and, secondly, that his own experimental work on the acidity of root sap, initiated, as he states, because "it has long been accepted as a fact* that plants help themselves to a part of their mineral food by means of the solvent action of their acid root sap on the particles of soil" had indicated "that the ratio of the soluble free acid in the roots of plants to the moisture contained in them probably generally falls within 1 per cent. calculated as crystallised citric acid."

As DYER's method was long accepted in England, and is the one used in New Zealand in endeavouring to determine the manurial requirements of soils, it is our duty to treat it more fully. A portion of soil is placed in a bottle with a quantity of the 1 per cent. citric acid solution, and after standing seven days, during which it is shaken from time to time, some of the clear liquid is taken off and analysed. The soils dealt with by DYER were the plots on the famous Hoos Field, on which barley had been grown for forty years in succession, and which had been year after year subjected to some kind of unvarying manurial treatment. The following table summarises his results as regards phosphoric acid:—

	Plots without Phosphate for 40 years.	Plots with Phosphate every year for 40 years.
Total percentage of Phosphoric acid	0·105	0·177
Percentage of Phosphoric acid soluble in 1 per cent. Citric Acid solution	0·0078	0·0463
Barley Yield, average per annum for 38 years ...	29½ bushels.	39⅛ bushels.

* This theory has since been shown to be untenable.

After a careful consideration of the whole of his results DYER makes the following guarded statement:—"It would, perhaps, not be unreasonable to suggest that when a soil is found to contain as little as about 0·01 per cent. of phosphoric acid soluble in a 1 per cent. solution of citric acid it would be justifiable to assume that it stands in immediate need of phosphatic manure." As regards potash, he says that it is more difficult "to draw from the figures any fairly plausible suggestion as to what percentage limit of citric acid soluble potash should be regarded as marking the non-necessity of special potash applications. Probably this limit lies below 0·005 per cent."

DYER's method is still the best analytical method we have of determining probably available plant food, but as a means of discovering the manurial requirements of soils it has now lost authoritative support. It had, indeed, an exceptionally good reception, probably a better one than the author himself expected for it; for what argument can there be that analytical methods that illustrate the lack of readily soluble minerals in a field continuously cropped with barley and unmanured for forty years should be of universal application? How totally different in every respect from the Hoos Field are our New Zealand soils, and how different the methods of farming them! To apply the test to Canterbury soils we may quote the figures of MR. ASTON in the JOURNAL OF AGRICULTURE for August, 1913. Here he shows that of 41 soils dealt with, only 3, that is 7 per cent., are deficient in available phosphoric acid, while 30 samples, or 73 per cent., are rated as "good." Yet there is little doubt that in practically all Canterbury soils phosphatic manuring will give a gratifying result. The average of two analyses of Ruakura Experimental Farm soils shows 0·017 per cent. of potash, and 0·036 per cent. of phosphoric acid soluble in citric acid solution; yet a phosphate and potash manure, according to the JOURNAL of June, 1912, converted a 2·98 ton crop of oats into a 4-ton crop; while in the JOURNAL of September, 1913, is a record of an increase of 43·5 tons per acre in the swede crop produced by phosphatic manuring.

The truth is, as MR. A. D. HALL points out in his book on "The Soil," that the so-called "available" plant food represents not that which the succeeding crop will remove, but that which it can draw upon; how much it will acquire will depend on a variety of factors, such as the nature of the plant, the texture of the soil, the supply of water, and other necessaries of nutrition." Thus the fertility and crop-producing capacity of a given soil depends on an infinite variety of characters, on a small part only of which a dim light is shed by means of chemical analysis; and to quote DR. RUSSELL, "it is manifestly impossible for the chemist to make a satisfactory report on a sample of soil on the basis of analytical data only."

The reader has, by this time, perhaps, concluded that the chemist is a rather useless member of the fraternity of agricultural scientists, and we must therefore crave further space to show the legitimate functions of this worker in elucidating problems of fertility. It has been said that fertility depends largely on water supply, and this again is controlled mainly by the texture and physical characters of the soil, the relative proportions of sand, silt, clay, etc. The general character of the soil as regards these features is under consideration by the practical man when he classes a soil as heavy, medium, or light land. Rough classification of this kind is reduced to exactness by means of a "mechanical" analysis, whereby the soil particles are freed from one another, and separated according to size into groups: coarse sand, fine sand, silt, fine

silt and clay. Again, the amount of humus in a soil is an important quantity as bearing on the water-holding capacity of a soil, apart from the question of plant food furnished by it. So also the quantity of carbonate of lime is a desideratum. Thus by means of mechanical analysis, together with determinations of humus and carbonate of lime, we get a complete view of the whole soil, whereas by chemical analysis we get a glimpse of a small part of it only —the part soluble in acids. With this more comprehensive knowledge, we are enabled to make much more reliable comparisons between soils, showing which are fundamentally identical, and in what respects others differ. By this means the soils of a given area are classified into groups or types, and it then remains to make, first, a more detailed chemical examination of representatives of these types; and, secondly, a study in the field of their cropping capacity, response to fertilisers, and other characters of direct practical importance. Thus the first work of a soil-chemist in investigating the soils of any area, is to collect, systematise, and correlate all possible information, both of a practical and of a purely scientific character, of soils in the area, the management of which is well understood as a result of practical experience. Then, and not till then, is he in a position to give reliable advice regarding the treatment of new soils in the area, and to satisfy the requirements of the farmer, which are usually direct and to the point. "He does not want to know to what type his soil belongs, but how he must manure it, etc. If the analyst has an adequate knowledge of the soil type and the locality he can readily ascertain in what respect the soil differs from the type, and then, from the known results of manurial and other trials on that type, he can give the information wanted with a reasonable degree of probability; otherwise his report can only be a matter of guesswork. In short, the farmer's problem can only be satisfactorily solved, and the manurial trials fully interpreted, only when a complete soil survey has been made." As regards the field experiment part of this work one could wish that the Department of Agriculture would site their plots and plan their trials, bearing in mind the necessity of a soil survey, instead of indulging so much in the somewhat unmethodical experimentation at present in vogue.

In thus stating the position of the chemical analysis of soils, we are merely following the leading British authorities,* as represented by such men as MR. A. D. HALL, late Director of Rothamsted, and DR. RUSSELL, the present Director. The quotation just cited is from a recent work† by the last named writer, a book which is undoubtedly the most authoritative exposition of questions of soil chemistry to which our language gives us access.

It only remains to add that this College discourages the sending in of samples with requests for analysis and report on most suitable manurial treatment. The fundamental work must first be done, namely, a soil survey of Canterbury, and in the hands of workers whose time is occupied with other problems as well, this can only proceed slowly. Carefully drawn samples of soil and subsoil, with information regarding their agricultural characteristics, will be welcomed, but just at present the farmer can do more for the soil survey than the chemist can do for the farmer.—JOUR. OF THE CANTERBURY AGRICULTURAL AND PASTORAL ASSOCIATION.

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* American writers are very strong in their condemnation of chemical analysis as a means of determining soil fertility.

† Soil Conditions and Plant Growth, by E. J. RUSSELL, D. Sc., Longmans, Green & Co., 1915.

PAPER PULP.

THE PAPER SHORTAGE—ITS CAUSE AND SOME EFFECTS.

At a meeting of the City of London Tradesmen's Club held on the 13th ult., MR. WM. C. CORKE, a Past President, who is a member of the firm of MESSRS. C. E. CORKE and Co., paper agents, of Ludgate Hill, E.C., read a paper on "The Paper Shortage—its Cause and Some Effects." MR. CORKE outlined in a very interesting manner the situation created in the paper trade at the outbreak of the war, and referred to the difficulties which had since been encountered by the industry. The Swedish embargo on chemical pulp, the formation of the Paper Commission, and the reduction of imports of pulp and paper were also referred to. Alluding to the fact that Germany's pre-war exports of paper to the British Empire reached the value of £2,000,000, he expressed the hope that we should never again allow Germany to get a grip on our Colonial trade. At present, however, we were unable to fulfil the demands of our Colonies, and of Japan and China, and he was afraid the Americans would get hold of a large amount of our Colonial trade, and would make a bold bid for our trade in the Far East. MR. CORKE said that though there was an embargo prohibiting the exportation of chemical pulp to this country from Sweden, there was no restriction existing against the importation of Swedish paper. This, he thought, was a great injustice to the English paper-maker. The necessity for economy in the use of paper was emphasised, and MR. CORKE suggested that if the percentage of returns of newspapers could be cut down to about 5 or 7½ per cent. it would cause no inconvenience to the general public, while at the same time it would do away entirely with street newspaper selling, which he considered was a most dangerous avocation for young lads. Concluding with a reference to Canada and Newfoundland as excellent sources of wood pulp supplies, MR. CORKE trusted that the future would never again find us dependent on a foreign country for the life-breath of our industries.—THE PAPER-MAKER AND BRITISH PAPER TRADE JOURNAL.

NEW PAPER MAKING FIBRES.

The following is extracted from the Review of the year 1915 appearing in the PAPER MAKER AND BRITISH PAPER TRADE JOURNAL:—

Every year the necessity grows more and more apparent for the extension of the world's resources in paper-making materials. Rags, esparto, and wood pulp continue to furnish paper manufacturers with their staple "stock," but the constantly increasing demand for paper in all parts of the world and the advancing cost of pulp wood have, during the past few years, led to a

more assiduous search for and study of new fibres which may prove technically and commercially suitable for the production of paper.

Among pulp woods, spruce still forms the main source of supply, but a steadily increasing use is also being made of balsam fir, poplar, white birch, jack pine and hemlock, particularly in the western hemisphere. Bass wood and elm have also been converted into mechanical pulp and used mostly for fibre wall-boards. Considerable anxiety has been felt in some quarters lest the huge demands upon the Canadian, American and Scandinavian pulp wood areas should eventually lead to the depletion of the world's timber forests, but with a better appreciation of the science of forestry, greater discrimination in cutting operations, more effective prevention of loss by forest fires, the establishment of immense forest reserves in the New World, and the existence of great resources in Russia, there seems to be no reason for alarm.

Bamboo may now be considered to have established itself as a valuable raw material for the manufacture of paper in India and the Far East, where baib or sabai grass also is still extensively employed for the purpose.

Among other more or less promising fibres to which attention has been directed are the Savannah grasses of Northern and Central India, concerning which MR. W. RAITT, F.C.S., of the Forest Research Institute, Dehra Dun, holds hopeful views. Moya grass, which grows over large areas in the hills of the Central Provinces of India, has also been experimented with, and is stated to yield 39 per cent. of easy bleaching pulp similar in quality to that obtained from baib grass. Lallang as a paper-making material has also claims to consideration, especially when used with other kinds of pulp, and during recent years MR. CLAYTON BEADLE and DR. STEVENS have introduced *Hedychium coronarium* as a promising fibre from the paper-maker's point of view. They have, indeed, succeeded in producing, without the addition of sizing material, strong kraft paper from the living plant to the finished paper in a period of four hours.

Marram grass, which occurs on most of the sandy shores of the British coast line, is said to have very promising paper-making qualities, MESSRS. BEADLE and STEVENS stating that paper made from this fibre has much the same appearance as that made from esparto. Papyrus grass, experiments have shown, can be made into a satisfactory paper of good strength, but owing to the rather low yield of pulp and the bulky nature of the grass it is doubtful whether it would be commercially successful. Tambookie grass and Spanish reed from the Transvaal are also said to be capable of making good paper, while other African fibres to which attention has been attracted are those of the baobab (or monkey bread) tree and elephant grass. The Federated Malay States are considered to have in pine-apple leaves and the Nipa palm paper making fibres of considerable value. A selected sample of pine-apple leaves yielded as much as 73 per cent. of useful fibre, and experiments with Nipa palm show its adaptability to the cheap production of box boards and tough wrapping paper. Tapa cloth fibre has also been considered to be of a quality superior even to bamboo.

Numerous other fibres have either been tested with more or less successful results or considered as possessing qualities worthy of investigation in the interests of paper. These include cotton seed cotton, obtained from the

down of the cotton seed by a process of dry mechanical separation, from which excellent paper has been made; corn and cotton stalks, sugar cane, spent hops, Spanish broom, bear grass, Delta grass, and others.

More recently a French paper-maker is stated to have discovered a practical and economical process for the production of paper mill from the leaf of maize, pulp made from which has already been adopted in some cigarette paper mills, while it also makes a very strong paper without much sizing.

Another aspirant to pulp-making honours is a certain grass grown in the Tarai (India), known locally as "ulla." It was experimented with at the Allahabad Exhibition, and was most favourably reported upon by a pulp expert. The pulp then produced was afterwards brought to this country and some paper manufacturers are stated to have declared it to be of as fine a quality as any produced in any quarter of the world. From the Dutch West Indies comes intelligence of a project for the export of possentry wood, with the object of preparing it in such a way as to fit it for the manufacture of paper. MR. R. W. SINDALL is stated to have spoken highly of its possibilities. Attention has also been called to Zacaton grass, which grows from California and Texas southward to the Argentine Andes, as a suitable paper-making material. Laboratory tests conducted by the United States Department of Agriculture show that it can be chemically reduced to paper stock by the soda process more easily and with less expense than is necessary to produce poplar wood.

TOMATO CULTURE.

The general method of training which has proved to be productive of the best results is to confine each plant to a single stem. This is done by pinching out all side growths as soon as they can be easily grasped between the thumb and finger. These side growths can easily be distinguished from the incipient flower trusses, not only by their appearance but also because they almost invariably proceed from the axil of the leaf stems. Occasionally one finds that a growth will appear at the end of the flower truss after the flowers have opened. This should always be pinched out, the only thing to be encouraged being the main growth and, of course, the development of the fruit and the flower trusses. When the main growth has reached five or six feet, or as high as the growth can extend if this be a shorter distance, the top should be cut out and all the energy of the plant be devoted to the maturing of the fruit. When the trusses bear a large number of fruits it may be necessary to give it some support by looping the truss up with raffia grass or string.—LONDON TIMES.

SERICULTURE IN SOUTH INDIA.

T. V. RAMAKRISHNA AIYAR.

(Continued from p. 26, Vol. XLVII.)

From the above accounts it is evident that there is a great deal of difference between Kollegal and Berigai in the methods of mulberry cultivation. At the latter place the methods adopted more or less approach those in Bengal. It is also apparently very expensive compared to Kollegal figures. While the Kollegal ryot spends only Rs. 10/- per acre, the mulberry farmer at Berigai spends Rs. 10/- over a plot which is less than a twelfth of an acre. Being small holders they bestow additional trouble and expense over the plot in order that they may get the highest possible income from their small plots. There is not a single mulberry farmer in Berigai who owns a full acre of mulberry land who cultivates the area on his own accord in this thorough and expensive manner. All lands are divided into 3 gunta blocks chiefly and leased out to silk farmers.

In both these places leaf picking takes place five times in the year and thus five crops of cocoons are generally raised.

DISEASES OF MULBERRY.

The mulberry plant in these two localities though not subject to any serious pests, now and then gets diseased and silk rearers suffer as they cannot feed worms with diseased leaves. In Kollegal there are two diseases known as *Butha mari* and *Chirkulli mari*. The former is said to be caused by minute insects at the back of tender leaves—very probably plant lice, scales, or thrips. *Chirkulli mari* is a kind of leaf curling, the cause of which is not known. In Berigai, likewise, two are known as *Rahkarza* or *Budithirogaamu* and *Angarkarza* or *Akki rogamu*. In the former the attacked leaves turn ashy in colour and in the latter the leaves gradually dry up, the causes of both being unknown.

OUT-TURN.

The out-turn in mulberry cultivation is differently calculated in the two places. In Kollegal where the mulberry grower does not generally rear silk worms, the leaf is disposed of at every picking. The foliage is sold either wholesale or retail. In the latter case, the price is calculated according to each head, load or *Moottai* and according to the quality the prices vary from 4 annas to Rs. 2 or 3 per mootai. The average out-turn of foliage for a year from a fairly well cultivated plot one acre in area is from 40 to 50 moottais and at a moderate price would fetch Rs. 75. In Berigai, on the other hand, the foliage is not sold but the grower uses it up for his own worms and as such the out-turn can be calculated only from the amount of raw silk he is able to get by feeding worms on the foliage got from his plot. The Berigai ryot is able to rear twelve trays of ripe worms from the foliage of 3 guntas in

a year. Thus from an acre in one year he can rear 160 trays. Now, bringing the Kollegal out-turn also to this category we find that with the yield of one acre he is able to rear 48 trays of ripe worms. Thus in cocoons:—

With 1 acre foliage quantity of cocoons reared in a year in Kollegal 12 maunds at Rs. 12-8-0, Rs. 150-0-0.

With 1 acre foliage quantity of cocoons reared in a year in Berigai, 40 maunds, Rs. 500-0-0.

The following tabular statement in which is also included for comparison the estimates of mulberry cultivation in Bengal will clearly show the expenses and income. In this table the rent of the land and the expenses involved in rearing; appliances, labour, etc., are not included. The area is one acre.

Localities.	Initial outlay	Annual outlay.	Total at 2nd year.	Out-turn of silk.	Price of silk.	Profit.
Kollegal ..	17 0 0	8 8 0	25 8 0	12 mds.	Rs. 150	124 8 0
Berigai ...	133 5 4	40 0 0	173 5 4	40 ,,	,, 500	326 10 8
Bengal ...	145 0 0	70 0 0	215 0 0	48 ,,	,, 600	385 0 0

Maund in all cases = 25 lb. each or 1,000 tolas.

THE CULTIVATION OF THE SILKWORM.

The cultivation of silkworms in Kollegal is chiefly in the hands of low caste Hindus and Muhammedans. Of the former the Gangadiars and Pariahs stand foremost. Recently, however, it is gratifying to find that some lingayets called in Kollegal, Sivachars, have also taken to silkworm rearing. In Berigai on the other hand almost all the silkworm cultivators are Muhammedans. The methods followed in rearing the worms and the various appliances used are almost the same in both the localities.

HOUSING OF THE WORMS.

Generally no separate house or shed is built to house the silk worms. They are kept in odd corners of dwelling houses themselves. Sometimes the trays of worms are kept in dusty ill-ventilated rooms which appear more like grain godowns; at other times we find them kept in open verandahs close to the cow-stalls and very often in the same room where the members of household sleep, eat and spend the greater part of their day we find sllkworms also housed. In poor huts in Alhalli near Kollegal I have found one or two stands with trays of worms kept in the corner of a dingy cooking room crammed with various other things. There is thus no special attention paid to the housing. The householder sets apart a portion of his dwelling house according to his convenience.

REARING APPLIANCES.

The different appliances used in rearing the silkworm are (1) *Meja or Dheda.* This is a stand or rack to keep trays of silkworms. The term *Meja* used in Kollegal is evidently a corrupt form of the Bengali synonym 'Machan.' Generally each meja is constructed to hold 24 trays of worms in two adjacent vertical rows of 12 each. Each stand is supported by six upright posts arranged in 3 pairs and these are connected by means of horizontal cross pieces, there being 24 such cross pieces, 12 attached to one side and 12 along the other. This gives two vertical rows and room for 24 trays. The uprights are generally of strong bamboo or wood and the cross pieces are

slender solid bamboos driven through holes bored on the upright posts. In height a stand measures 6 ft. to 6½ ft.; it is 8 ft. to 9 ft. broad and 3 ft. to 3½ ft. deep. One such stand costs from Rs. 4 to 5. In Berigai the stands are single file ones viz., with one vertical row having room for only 12 trays. The upright posts of the stand are often placed on crude granite antpans to keep away ants from attacking the worms.

THATTAS.

These are trays for keeping the worms. They are made of bamboo matting and are circular in shape. The edge all round is turned up an inch or two. Each is 3 ft. to 3½ ft. in diameter and fits the shelf in a meja. In Kollegal these sell at 3 to 4 for a Rupee. In Berigai they are somewhat dearer.

CHENDRIKES.

These are spinning trays in which the ripe worms from the thattas are put in for spinning their cocoons. This term is again a corrupted or almost the same form of the Bengali synonym *Chandraki*. Each chendraki is a frame work made up of bamboo matting with a spiral ledge of the same material upon this screen-like surface. The spiral ledge is about 1½ in. in breadth. This arrangement is to give the worms as many attaching surfaces as possible. The Kollegal chendrike generally measures 4 ft. by 6 ft. The bamboo screen is attached to two long poles, one on each side. A third supporting pole is temporarily fixed at the back when the chendrike has to be exposed to the sun with the worms. The screens sell at from 2 to 3 for a rupee. In Berigai there is no fixity of size with regard to chendrikes. They are of different sizes. Some are often very big and found used as screens in house verandahs when not in use.

To the above important appliances must be added also the following, to complete the outfit for silk rearing: a leaf chopping hatchet called *kudukalu* in Kollegal and a few leaf gathering baskets.

With these appliances and with the necessary food supply arranged, one starts a brood. To start the brood fresh seed cocoons are purchased from rearers who rear worms at certain season purely for seeds at from Re. 1 or 1/4 to Rs. 2/8 a thousand according to the size, colour and general quality of the cocoon. It has been found that disease-free seeds are very rarely met with and one of the primary causes for the decline of the industry is the want of the good selected disease-free seed cocoons.

OXALIS.

The treatment of a plot with an area of 198 sq.ft. was started on 3rd August. The soil was turned over to a depth of 2 inches with a spade and the operation will be carried out every 3 or 4 weeks.—PROGRESS REPT. HAK. BOT. GDNS.

ENTOMOLOGY.

THE BANANA WEEVIL.

In a recent number of the Jamaica GLEANER, there appeared a lecture delivered at Hope, by MR. A. H. RITCHIE, B.A., Government Entomologist, on the occurrence of the banana weevil in Jamaica. This insect was also lately referred to in the JOURNAL OF THE JAMAICA AGRICULTURAL SOCIETY.

From these references it appears that the banana weevil *(Sphenophorus sordidus=Cosmopolites sordida)* has appeared in some numbers in certain districts in Jamaica.

This insect appears to be very widely distributed throughout the tropics of the world, being found in Jamaica, Guadeloupe, Dominica, Martinique and Trinidad, in the West Indies ; Brazil, in South America; and in the Philippines, Fiji, Borneo, Sumatra, India, Queensland, and Straits Settlements in the East.

There are in the genera *Metamasius*, *Sphenophorus*, *and Cosmopolites*, several weevils closely related to each other and to *Cosmopolites sordida*, which attack bananas in many localities ; but while these perhaps attack other plants also, the insect which is now being designated as *Cosmopolites sordida* appears to attack bananas only.

In Fiji, the banana weevil has become seriously abundant, and in 1912, the Government Entomologist, MR. F. P. JEPSON, visited Java in quest of natural enemies of this pest. He was successful in finding a Histerid beetle, which in both adult and larval stages is predaceous on the grubs of the banana weevil. He successfully introduced this predaceous beetle into Fiji.

In 1900, the banana weevil developed a serious attack on plantains in Dominica, and more recently it has been found in some numbers in Martinique and in Trinidad.

This insect would appear to be one which has been carried from place to place in banana plants distributed for purposes of propagation, and has probably existed for some time in most, if not all, the localities where it now occurs.

Its mode of life renders it a difficult pest to control. The egg, larval and pupal stages are passed in or on the bulb of the banana or plantain. The adults do not move far from the place where they have lived and developed so long as suitable food is available to attract the egg-laying female.

The spread of the insect from one locality to another is probably accomplished by the transportation of infested suckers for planting, and its spread within any locality most likely follows the killing out of infested stools, when the adults would travel in search of fresh supplies of food plants.

The digging out and destroying of all stools of plantain and banana found to be infested, and the planting of suckers free from infestation would appear to be the only practical remedies for checking the increase of the pest, at present known.—H. A. B. IN AGRICULTURAL NEWS.

PEST OF THE BANANA.

The banana weevil borer, *Cosmopolites* (*Sphenophorus*) *sordidus*, is said to cause an annual loss in Fiji of many thousands of pounds and is most difficult to deal with, as its whole life is spent in the under-ground stem or in the soil. Young suckers wither and die, and the first evidence of attack is the death of the young leaves while still unrolled when cut open, the "bulb" is found to be riddled by the larvæ; older plants do not seem to be so seriously affected. The adult weevils are found in quantity in the soil round the roots and also sheltering under dead leaves at the base of the stem. The eggs are believed to be deposited singly on the base of the stem about half an inch above the level of the soil. The larval stage lasts about 20 days and the pupal stage 6-8 days. The length of life of the adults is not known but they will live in dry earth for three months without food, and not longer than 17 weeks with food; crop rotation and very clean cultivation are suggested as remedies and parasites should be utilized if they can be found. [*C. sordidus* is found in banana-growing areas in the Old World tropics from Madagascar eastward to Fiji, as well as in Brazil and the West Indies.] A common West Indian species is *Metamasius* (*Sphenophorus*) *sericeus*, while *S. liratus* occurs in Martinique; *Rhabdocnemis* (S) *obscurus* in Papua, the Sandwich, Solomon and Society Islands attacks bananas as well as other plants, while in Queensland it only attacks sugar cane, *Ligyrus ebenus* (*Tomarus bituberculatus*) damages the leaves in the West Indies and tropical America, the burning of badly attacked leaves being the best remedy. In South America and Trinidad the larva of a large moth, *Castnia licus*, bores in the stem of bananas as well as of sugar cane. The so-called banana "scab" in Fiji is due to the larvæ of a small moth [*Nacoleia octosema*, Meyr., also recorded from Java and Queensland]; minute longitudinal cracks are found on the incurved side of the fruit, and these increase in size and may extend to the edible portion, which then begins to decay; dusting with pyrethrum powder is recommended against it. In New Zealand the ripe-rot fly, *Drosophila ampelophila* attacks all kinds of fruit in warm weather, whether growing or cut. The fruit-fly, *Dacus ferrugineus* F. (*tryoni*, Frog), punctures the skin of the unripe fruit and oviposits in the hole made; a black spot results, and the larvæ burrow into the pulp and set up decay; when only a few days old the larva passes out of the fruit and drops to the ground to pupate. TYRON recommends the eradication of breeding grounds near banana plantations, and the destruction of bananas and all other infested fruit, as well as of all wild fruit trees. In South Australia the use of woven covers was formerly compulsory and is effective if applied when the fruit is two-thirds grown. Another fruit fly, *Dacus curvipennis*, has been bred by FROGGATT from bananas shipped from Suva, though no specimens have actually been found in Fiji. In Surinam small black bees, in searching for honey, scar the very young fruits and render it unsaleable when full grown. One estate lost 15,000 bunches from these attacks in one year.—REVIEW OF APPLIED ENTOMOLOGY.

CO-OPERATION.

CO-OPERATIVE MOVEMENT IN CEYLON.

TWO ANNUAL REPORTS.

Report of the Kumbukke Pattu Co-operative Credit Society for the year 1915–16 presented at the Annual General Meeting held on the 11th July, 1916.

Meetings.—During the year under review 11 Committee meetings were held. There was no necessity to convene any special general meetings.

Membership.—16 new members have joined since 1st April 1915 (who have contributed the value of 94 shares) bringing the total of membership to 86.

Capital.—The nominal capital of the Society is Rs. 2,000 divided into 2,000 shares. Out of these 1,109 shares have been disposed of bringing the paid up capital to Rs. 1,109.

Loans.—Rs. 1,165 were given out on loans to 26 members. Of these 8 loans are for cultivating lands; 6 for leasing out lands; 5 for trading; 3 for carpentry work; 1 for buying requisites for a printing machine; 1 for brass work and the other for buying an oil mill for coconut. Rs. 1,003·75 have been recovered on account of loans together with the interest due. All loans have been repaid in at the due dates.

Manure.—Six tons of manure were received from the Commercial Company, Colombo, during the last season. This has helped members as the manure was sold among members at a cheaper rate than could have been purchased locally.

Profits.—Rs. 91·25 have been received on account of interest on loans given to members and Rs 2·70 on account of Bank interest. Out of these Rs. 3·20 has been spent in purchasing a rubber stamp for the Society and Rs. 15 has been spent on stamps, stationery and travelling expenses of the Secretary. This leaves a profit of Rs. 75·75. Profit received during first year having been Rs. 26·25, there is now a total profit of Rs. 102 which has been set apart for the reserve fund.

General.—On the whole the working of the Society was satisfactory. Though there were 12 meetings to be held members sat only on 11 occasions and the other meeting had to be abandoned owing to floods. Working of the Society is progressing daily. No members resigned from the Society or applied to withdraw the deposits. They all have great confidence in the Society. *All members dealing with the Society have helped its progress by payment of loans at due dates.*

GATE MUDALIYAR J. A. WIRASINHE, the President of the Society, presided at all the 11 meetings. This gave a great status to the Society and the members are very thankful to the Mudaliyar for presiding.

The Society has applied for a loan from Government and it is understood the loan has been sanctioned.

It is hoped that the members will take increased interest in the work of the Society next year in order to show a still more satisfactory report of progress.

Sd. J. A. WIRASINHA, President.

Sd. J. KANNANGARA, Secretary.

KALAPALUWAWA CO-OPERATIVE CREDIT SOCIETY.

The report of the Committee of the Kalapaluwawa Janabhiwurdhi Co-operative Credit Society for the year ended on March 31st, 1916.

Membership.—On March 31st was 121, showing an increase of 23 over last year.

The Capital.—The paid up capital now amounts to Rs. 687·75, an increase of Rs. 297·75 and with the loan taken from the Government, the reserve fund in the bank and the interest on loans, the money in the hands of the Society amount to Rs. 984·79.

Loans aggregating Rs. 1,080 have been given to 33 members during the year under review. From the beginning of the Society the number of loans given amounts to Rs. 1,945.

Loans were given for the following objects:—

6	for paddy cultivation	amount	... Rs. 160
4	,, growing vegetables	,,	... ,, 85
6	,, trade	,,	... ,, 180
7	,, building and repairing houses	,,	... ,, 220
5	,, buying carts, bulls, and for earning a livelihood	,,	... ,, 165
5	,, redeeming mortgages	,,	... ,, 270
			Rs. 1,080

Agriculture.—There has been some improvement in agriculture. Gardening has been pursued more extensively than ever before. A large area has been brought under paddy cultivation.

A new venture for cultivating paddy fields has been started in some members raising a small capital for this purpose. In this way a little over 3 bushels of paddy have been sown. This venture will, we hope, enlarge and lead to the cultivation of all paddy fields in the village.

The advantages of undertakings of this kind are very great. It helps people who are too poor to cultivate their fields to have them cultivated, it distributes the profits among a larger circle; if any loss actually fall, the loss lights less burdensomely on individuals than it would be if cultivation was done by single cultivators. Besides, it would considerably facilitate the introduction of new methods of cultivation and the cultivation of fields which have not been brought under the plough for many years.

Committee Meetings have been regularly held every month except in the months of June, July and August due to the prevalence of martial law and the rains. These meetings were always preceded by informal meetings of the members at which addresses were sometimes given, articles from the "GOVIKAM SANGARAWA" (Sinhalese Agricultural Magazine) read, or some topic of general interest especially regarding agriculture discussed.

General Meeting.—No general meeting was held since the last annual meeting, as no business which the Committee could not transact came up.

C. A. BOTEJU,
President.

S. F. AMARASINHE,
Secretary.

MANURES.

CO-OPERATIVE SUPPLY.

In Europe the supply of manures is one of the largest businesses of the agricultural co-operative societies, and it is a very profitable one to the societies. There is a wide margin between wholesale and retail rates, and the manufacturer is generally willing to sell cheaper in large quantities. It may be mentioned that a firm engaged in oil crushing in the United Provinces offered to sell *mohwa* cake at 2½ annas per maund, instead of 4 annas, if taken in quantities of over 10,000 maunds. This would permit the society to sell below market rates and still retain a handsome profit. In other parts of India rather more progress seems to have been made. At the last meeting of the Board of Agriculture it was stated that "In the case of manure societies, a notable success has been achieved at Kelva Mahim near Bombay where in a tract of very intensive culture, with a large demand for castor cake, the first year's operations, on the basis of a co-operative capital of Rs. 7,500, a profit of 25 per cent. has been secured and the cake sold below the market rate. As another result the market rate has been much lower than it would have otherwise been. In this case the co-operators were almost exclusively the gardeners themselves, but the management was in the hands of a keen local man, not however a gardener. A larger manure supply society has recently been promoted in one of the sugar-cane tracts in the Deccan, with a capital of Rs. 20,000. It has succeeded in coming out satisfactorily from the first year's trading, though there will be no longer actual profit, but it has caused the price of fish-manure (in which it dealt) not to rise as was invariably the case in former years. The results of its experience is to indicate that such a society is best run when the shareholders are co-operative credit societies who can buy for the benefit of their members rather than individual cultivators."—MADRAS MAIL.

NOTES ON THE ORGANISATION OF A CO-OPERATIVE CREDIT SOCIETY.

The Ordinance No. 7 of 1911 provides the constitution and management of a Co-operative Credit Society.

1. *Membership.* A society should have not less than 10 members. Any person (male or female) over 18 years of age is eligible for membership.

2. *Area.* Each society should have its area defined. Societies may be formed for one village, a group of villages, a Korale or Pattu, or a district. Residents outside the defined area can join the society only with the approval of the Registrar.

3. *Capital.* The capital of a society may be raised in two ways:—either (*a*) by subscription, each member paying a sum more than Rs. 5/- or (*b*) by issue of shares. The value of each share is fixed by the members themselves and may be 50 cents or Re. 1/- or more, payable in one or more instalments. A member cannot purchase less than one share but he may purchase more than one though not more than one-fifth of the total number issued.

4. *Entrance fee.* If considered desirable the members of a society may levy an entrance fee of 5 to 25 cents payable by each member, in order to meet the Society's initial expenditure on stationery, etc., though this is not necessary when subscriptions are paid. *On no account can the share capital of the society or deposits be utilized for any expenses.*

5. *Objects.* The main object of a Co-operative Credit Society is to lend money on easy terms for productive and useful purposes. It may lend seed paddy and manure also. No society can engage itself in any speculative business whatever. Members must utilize the borrowed money for the purpose for which it was borrowed. The maximum loan to members, and the rate of interest chargeable, and such other matters should be regulated according to the by-laws of each society.

6. *Loans.* Repayments of loans may be arranged according to the convenience of the borrower and of the society, either by instalments or otherwise. Loans cannot be given for a period of over one year. Loans may be renewed annually in the case of failure to repay the loans, if good reasons be shown, according to the by-laws of the society. Compound interest cannot be charged on loans. A special form of bond for the use of the society for loans is available on application to the Registrar.

7. *Interest on loans and deposits.* Each society may fix its own rate of interest. The rate must be reasonable, say between 6 and 12 per cent per annum on loans to members and 3 to 5 per cent. per annum for deposits from members or loans from outsiders.

8. *Deposit.* Members may deposit money out of their savings in the society, which can then utilize such funds to give loans at a higher rate of interest than that paid to depositors.

9. *Borrowing.* Societies may borrow money, if need arises, from outside sources at a low rate of interest, with the approval of the Registrar.

10. *Liability of members.* Members' liability may be limited or unlimited. It is always desirable to make provision in the by-laws for unlimited liability, for the safety of the society's business. It is easier to borrow if liability is unlimited.

11. *Language in which books are kept.* The books and accounts of a society may be kept in English, Sinhalese or Tamil.

12. *Office-bearers.* Each society appoints its office-bearers annually at a General Meeting. The society should have a President, one or two Vice-Presidents, Secretary, Treasurer and a Committee to supervise its affairs.

13. *First step to be taken.* Having decided to form a society and the amount of capital to be raised, etc., the application form for registration of the society (which is available at the office of the Registrar) should be filled up, signed by 10 or more of the members, and forwarded to the Registrar through the Government Agent of the Province. In the case of a society started in an Assistant Government Agent's district, the application may be submitted to the Assistant Government Agent to be forwarded to the Government Agent. Names of members applying for registration should be written legibly.

14. *Certificate of registration.* On the registration of a society, the Registrar will send a certificate of registration, when the society will be entitled to all the advantages offered under the Ordinance.

15. *Office assistance.* The Secretary of the Board of Control, or the Inspector of societies, will attend a meeting of the society and supply the necessary books and forms, and also give all instructions for the framing of by-laws.

16. *By-laws.* By-laws should be forwarded (preferably along with the application for registration) for the approval of the Registrar.

17. *Custody of books.* Books, forms and all documents belonging to the society must be kept in the registered office, or in the case of being kept with any office-bearers that fact should be notified to the Registrar or may be made known in a by-law.

18. *Payment to office-bearers.* No society shall appoint paid officers. All officers must be honorary and they must be selected annually among members, but if the society finds sufficient profit in the course of its business after the formation of a Reserve Fund, as provided in the by-laws, such office-bearers as the Secretary or Clerk may be given an honorarium for his trouble in the form of a bonus.

19. *Custody of funds.* The funds of the society should be deposited in the Ceylon Savings Bank, Post Office Savings Bank or placed with a Banker approved by the Registrar. Arrangements have been made to allow of large sums of money being deposited in the Post Office Savings Bank, up to Rs. 5,000/-.

20. *Books and forms.* A society should have the following books and forms:—Minute book, Daily cash book, Members' register, Ledger and Pass books. Pass books will be supplied free to members; also forms of application for membership, form of loan bond and form of withdrawal of money from societies. These may be had on application to the office of the Registrar.

21. *Profits and Reserve Fund.* The profits of a society cannot be divided among the members until the Reserve Fund of the society reaches a certain proportion of the liability fixed by the by-laws.

22. *Types of societies.* Societies may be formed among agriculturists, clerks, artisans, carpenters, potters, fishermen, domestic servants, silver and gold smiths, shoe makers, factory hands, carters, rickshaw wallahs and others.

23. *Where information is available.* Specimen by-laws and all necessary information can be obtained from the Registrar or the Secretary of the Board of Control of Co-operative Credit Societies, Department of Agriculture, Peradeniya.

N. WICKRAMARATNE,

Secretary, Board of Control Co-operative Credit Societies.

Peradeniya, 9th August, 1916.

GENERAL.

DYEING INDUSTRY IN MADRAS.

DR. F. MARSDEN, PH. D., M.SC., Dyeing Expert to the Government of Madras, has submitted the following report to the local Government, covering the period October to December, 1915:—

Until the middle of November I was carrying on my work from the Leather Trades School, Washermanpet; then on receipt of Government orders proceeded to Bangalore to take up at the Indian Institute of Science the investigation of the indigenous dyeing materials which had been forwarded there.*

The question of the resuscitation of the use of roots and barks, etc., which were generally employed betore the advent of synthetic dyes has a fascination for many people and it is a difficult matter to convince them that the ever-extending use of factory-made products is not due to prejudice on the part of the dyer but is solely and entirely due to the fact that the manufacturers have studied his requirements, and with improvement succeeding improvement have made it possible for him to satisfy all tastes of the public as regards colour, and meet all demands as regards fastness, which can reasonably arise.

It is true that in India there is a large market for cheap dyes possessing nothing to recommend them but brilliancy of shade, but these are not to be looked upon as the standard by which the achievement of the colour chemist should be gauged, for their discovery and manufacture date from the early days of the dye manufacturing industry and in Europe their use is restricted to those purposes for which they alone are suitable, and for every class of trade, for every textile fibre; and for dyeing these at any stage of manufacture in suitable shades and degrees of fastness, synthetic dyes have long been available and have assisted in the creating of a textile industry in the midst of which one must live if its development is to be properly appreciated.

It was due to these considerations and the knowledge that the natural plant products could never meet the varied demands which had been created by the use of synthetic products that I have consistently tried to get others, who were not so much in touch with the industry and were without special knowledge of the conditions, to realize the futility of persevering in the idea that the plant products of the past could meet the demands which had been created by the developments of modern industry. We may regret it, but the fact is patent to any thinking unprejudiced person, and since business is conducted upon a basis of competition and guided by considerations of profit and loss those engaged in it will not lay much stress upon sentiment unless it is to their advantage to do so.

The sudden outbreak of the war however introduced a factor which had never been taken into account and in the early days it became evident that owing to the great hold which Germany had upon the dyestuff trade of the world we should, if the war lasted for any length of time, be faced with a dye famine. Therefore in August–September, 1914, enquiries were started with a view to alleviating the position, and the Agricultural Department and

*The Report of DR. MARSDEN on the results of the investigations conducted by him at the Indian Institute of Science, Bangalore, was published in the INDIAN TRADE JOURNAL of 3rd March, 1916.

certain Government officials were applied to for information with regard to the occurrence and cultivation of some of the better known indigenous dye materials of the past. The reply regarding the materials for red dyeing (the colour which is in greatest demand here) was not encouraging, for it was evident that there was no large area under cultivation and that a crop would take about three years to mature. There was, however, an uncertain quantity of material to be found in a wild state and in May, 1915, the Director of Industries sent a request throughout the Presidency that samples of indigenous dye materials should be collected and forwarded to him.

The response was not encouraging but sufficient was obtained for the purposes of investigation and it was decided to arrange with the Indian Institute of Science for the facilities available in that institution to be utilized. The Director of Commerce and Industries, Mysore, was also interested and in the end when I received orders to proceed to Bangalore bulk samples of a large number of products were collected there.

These included—

Dye materials.	*Tannin containing materials.*	*Diverse products.*
Chay root		Thandippa seeds
Nuna	Divi-divi	Alum
Vembadam bark	Myrabolams	Kasa leaf
Munjeet	Acacia bark	Lime,
Red sanders wood	Leaves of Woodfordia floribunda,	Etc.
Sappan wood	Etc.	
Cutch		
Annatto seeds		
Kapila powder		
Lac		
Indigo		
Leaves of Wrightia-tinctoria.		

I had beforehand forwarded data with regard to the treatment of the more important materials and under the guidance of the Institute staff an assistant appointed by the Director of Industries and Commerce had made good progress with the investigation. Attention had been mainly devoted to chay root, as the material giving the dye most nearly approaching alizarine, but it was evident that the amount of dyestuff contained was less than that contained in European madder and, if anything deeper than a pink shade were to be obtained, it would necessitate the employment of a weight of roots some four times that of the cotton to be dyed, and this would mean a succession of dyeings upon the same lot of material. I have since been shown a report by an old dyer upon the process he used to employ and from this I see that to obtain a full shade of red he had to repeat the dyeing operation some 6 to 8 times according to the depth of shade required. So long as any alizarine is available there is very little hope of dyers employing chay root in quantity and the experiments made upon the extraction of the dye, as also upon the removal of non-dyeing principles to yield a more concentrated product, showed that the improvement which resulted was by no means commensurate with the extra expense involved. This question of cost of dyeing is all-important and I noted in NEW INDIA some time since a statement by a correspondent that 500 lb. of madder root (I presume Indian madder) costing Rs. 155 would be required to dye a Madura red shade upon 100 lb. of cotton yarn and with alizarine selling at the time at 13 times more than pre-war prices the margin in favour of the synthetic product was Rs. 30

for cost of dye-material alone. Taking into account the extra expense for labour, increased amount of fuel and diminished production, the difference would be far greater than this. Even were the root able to complete as regards shade and cost of production the question of supplies is uncertain; Madura alone used alizarine equivalent to a supply of some 4 to 5,000 tons of roots per annum and since the commencement of the war some of the dyers there obtained a fair quantity of roots, hoping to keep their trade going with these. The result was most unsatisfactory as the extra labour required was considerable, the expense also was too great, and the shades produced were not equal to those obtained with alizarine. This last consideration would of course disappear in time, but so long as any imported alizarine is available or imported dyed yarns can be obtained by the weavers, the ordinary market shades will be the standard and any others will not find a ready sale.

Chay root gives a rather bluer shade of red than alizarine, whilst nuna gives a yellower one. All are equally fast but the pure red of the alizarine dye is what is aimed at and the fact that the natural roots do not give this and require to be used in large quantities to obtain reasonably full shades are against them. There is the same difficulty with nuna as with chay root, the supplies of root are very small, as a crop it would take some three years to mature, and the price is high. The quotation I have is Re. 1 per 3 lb. of roots so that the dyeing costs would be almost identical with those given above for chay root and put the material out of court for commercial dyeing.

The possibility of using munjeet, vembadam bark, red sanders wood and sappan wood for red was investigated, but with munjeet the shades were too thin, and tending to orange on an alum mordant; vembadam bark gave shades which were too dull and insufficiently fast to permit of their extended application; and with sappan wood and red sanders, although the former gave a bright crimson shade this is so fugitive to light that a day's exposure appreciably affected it and the latter gave only brownish shades for which there is no demand. The dyeing trials were made upon alum mordanted cotton as this is the mordant most readily obtainable by the Indian dyer; in Europe it was the custom to dye red sanders upon a tin mordant whereby a dull crimson was obtained but the expense of mordanting with tin salt is very high and it is not available to the Indian dyer, so it seemed out of place to suggest its use.

Were shades of a brown tone in favour here, cátechu or cutch is a material which gives dyeings fast to both light and washing when applied in combination with sulphate of copper and bichromate of potassium. It was largely used in Europe and the method of dyeing was well-known but the shades upon the bundles of yarn we have dyed with this colour have not appealed to any dyer I have seen and I am certain that it will not be much used in the Presidency.

Annatto (Javira) seeds, kapila powder and lac are three products which dye bright shades upon the fibres to which they are applied, but whereas annatto is dyed both upon cotton and silk (seldom upon wool), kapila can only be dyed upon silk, and lac although very good colour for wool and silk, can only be dyed in very thin shades (of uncertain fastness) upon cotton. The dyeing with annatto upon cotton is simple and especially upon bleached material the shade is rich and pleasing and although it is generally understood to be fugitive the trials I made convinced me that it is equal to the poorer aniline colours which are so much in demand.

The lac which I obtained was in the form of stick-lac and the dye was extracted by grinding and treatment with lukewarm water. The difficulty with this product is that the dye is often partially extracted by the people who collect the forest produce and the extract is evaporated and sold. The

information as to the process of extraction is contradictory and this appears to vary in different parts of the country, in some places water alone being used whilst in others a little soda, lime or alum is added. For wool-dyeing the question is of litttle moment as there the dyeing is carried out with the addition of sufficient acid to decompose the lime or alum compounds, but with silk the best results can only be obtained by extraction with water alone.

In dyeing silk with kapila powder the country method is to use oil, soda and alum and although in this way full rich shades are obtained this is not because of the method of applying the ingredients, but in spite of it. Soda and alum are mutually destructive and the only rational way to dye this product is to prepare the dye bath with the soda and oil (or a little soap in place of the latter) and after completing the dyeing at a moderately high temperature to rinse and remove the residual alkali by immersing in a separate bath of dilute acid or of alum and again rinse before drying. The dyeings made in this way were completed in a short time and left nothing to be desired as regards brightness and fastness of shade.

The only question with regard to the use of indigo is that of supply and, as it is stated that the leaves of the Wrightia tinctoria (the wood of which is used in toy-making at Chennapatna) were used as a source of blue dye, the matter appeared worthy of investigation. The first sample of leaves received was somewhat dry and upon steeping there was no trace of dye-stuff development; when freshly cut leaves however were taken fermentation took place and appeared to follow a course similar to that with the ordinary indigo plant. It was noticeable however that strongly smelling organic-sulphur compounds were liberated and simple æration of the fermented liquor produced little or no coloured deposit; addition of caustic alkali however to be freshly run off steeping water turned this to a deep yellow colour and this upon æration became green. Neutralisation of the alkali by the addition of acid destroyed the yellow and left a bright blue colour in suspension. Rough quantitative trials showed that the amount of blue colour obtained depended almost entirely upon the time elapsing between the cutting of the leaves and steeping but the best yield indicated that the dye contents of the leaves were lower than in the ordinary indigo plant and the necessity of using a large quantity of alkali and acid in the extraction would make the product more expensive than indigo itself. Although the dye-stuff obtained from Wrightia tinctoria behaves like indigo in many respects, I am not prepared to state that it is identical with ordinary indigo, for certain slight differences were noticeable in the experiments and above all the shade on a sample of yarn dyed by the ordinary vat method on a small scale has faded considerably within fourteen days, although only exposed to a very diffused light.

Of the other materials received it is only the tannin-containing ones which need be considered, lime, alum, kasa leaves, thandiappa seeds and such like products being merely assistants or developers with no tinctorial properties. In the majority of cases the tannin matters themselves which find application in dyeing are employed purely as assistants or fixing agents for other dyeing materials proper but sometimes advantage is taken of the coloured compounds they give with metallic salts to shade other dyes or even to produce a self-colour. The most important of these is undoubtedly the black compound with salts of iron, which is the basis of ink manufacture, and I have recently experienced how some Indian dyers have simply taken ink receipts as their guide and have attempted to apply the materials to yarn dyeing in a most unsuitable manner. One of the simplest receipts I have received is with ragi flour, iron, jaggery, keru and heera kasi (manifestly taken from the printing branch) but another is to take iron, mango seeds, myrabolams, divi-divi, "maful," alli leaves, nowsagar, herekay, palmyra jaggery, kallaganum bark and blaneo, place in cold water for eleven days and

then boil until all becomes hard. Afterwards to add nowsagar, chunam and mugambar when a good black is obtained, which however my correspondent finds "has no power." Seeing that the reactions have resulted in the production of an insoluble substance which cannot be made to penetrate the yarn I am not surprised.

All that is required to produce the black colour inside the yarn (where alone it is required) is to impregnate the material with the required solutions in successive stages.

First one soaks in a decoction of tannin matter (be it of gall nuts, myrabolams or divi-divi) and then, after simple wringing, work in a weak bath of milk of lime to fix the tannin.

It is necessary to rinse well to remove the excess of lime and then upon immersing in a solution of anna bedi (green copperas) the combination between iron and tannin takes place in the yarn, the bath remains clean and under control, and rinsing and drying complete the process. In many cases the treatment with lime is omitted but this results in the iron bath becoming highly discoloured and rapidly spoilt and only a greyish black shade is obtained upon the yarn, whereas after the lime bath it is easy to obtain quite a full black.

It is possible to improve the shade by topping with indigo, chay root etc., but of course this increases the cost of dyeing and the shades are never equal to those with aniline black, sulphide and direct blacks, to which the trade has been accustomed.

The result of the enquiry has been to convince me that natural dyewares will find only a very limited application so long as imported materials of any kind are available, and a glance at the mill exhibits and the cloths of the people visiting the Peoples' Park exhibition is sufficient to demonstrate the impossibility of plant products competing effectively with the modern factory-made dyes. People engaged in the trade have up to now taken little or no interest in the use of these materials upon cotton and all the enquiries I have had have been for the supply of the imported dye-wares which were in use. Some dyers have asked what substitutes could be used and I have, wherever possible, recommended and given instructions for dyeing the iron-tannin black, alone or topped with indigo, red woods, or roots, and also cutch, but the range of shade is so limited and the demand for red which cannot be met is so large that the position is very little altered. It is true that small quantities of dyes imported from England are reaching Bombay, but no details are given as to the colours and no quantity appears to reach Madras, unless it is that they are red dyes and serve as the basis of the so-called "new" products to which I drew attention in my last report. This mixture of aniline colour, yellow ochre and water, is being offered all over the country, not so far as I see by any of the erstwhile dealers in dye wares but by to me unknown sellers who have taken up the business in the expectation of large profits. This exploitation may account for the high prices which are being paid for dyes at present for whereas the dyes throughout the Presidency (as proved by inquiry in the various districts) will not offer more than five to six times the pre-war prices, the dyes are selling at 20 to 25 those amounts. Diluted with yellow ochre and water to contain but a small proportion of effective dye the product if sold at Re. 1 per pound would yield a handsome profit to the dealer and although the regular dyer knows by experience the relation between value and cost and so far as I am aware is not buying this product, the weaver and small man may be purchasing to meet his requirements for coloured material and does not realise the poor value he is getting.

The samples I have received have been from people wishing to take up agencies and sell the stuff and from these I gather that it is not only the

cheap Congo red which is being thus treated but also the more superior ones like the direct fast scarlets. It is certain that dyers who have any stock of dye find it more remunerative to sell the dye than to use it and I was informed by one man that the sale of one pound of dye was more profitable to him than the dyeing of one bale of yarn.

The enquiries I have had in a few cases have referred to the fixation upon cotton of certain dyes which only draw easily upon wool and silk. The mordanting materials required are used by every dyer in the West, but very very few Indian dyers seem to use them and appear to prefer the general method of fixation with alum which is not in this case very effective. Other enquirers have put questions upon the growing of indigo, but as in this branch I have no special knowledge the applicants were referred to the Agricultural Department.—THE INDIAN TRADE JOURNAL.

PLANTING CELERY.

It is still the common practice to grow celery in trenches and to blanch the stems by banking soil up against them in the autumn. There is no real need to do this for early celery, for the blanching may be as efficiently done by tying brown paper round the stems.

This is a more economic method, and is much cleaner than the older way. In such a case the celery may be planted in a line, the plants being set a foot apart. If there is to be more than one row the distance between them may be 18 in. Soil for celery needs to be fairly rich and capable of holding moisture. It is usual to prepare the ground a short time before planting by digging it deeply and working in a fair amount of rotten manure.

The plants should be carefully lifted from the bed in which they have been growing with a handfork, retaining as much soil as possible with the roots. When possible a dull period should be chosen for transplanting. All small suckers at the base of the young plants should be removed, and the plants should be set out with a trowel. The soil in which the celery has been growing should be moist at the time, but not wet, and after planting each plant should be given about half a pint of water.

CELERY IN TRENCHES.

Only early celery can be grown on the flat without the use of trenches That intended for late autumn and winter and spring use needs soil to be banked up against the stems to protect them from frost as well as to bleach them. The paper wrapping would not be a sufficient protection from severe frost. The trench for the late supply may now be made ready for setting out the plants in late June or early July. The trench may be 12 in. wide for a single and 18 in. for a double row. Economy would suggest a double row. Where more than one row is grown the distance between them should be 4 ft. for single and $4\frac{1}{2}$ ft. for double rows, the measurements to be taken from the middle of the trench.

When the length and width of the trench has been marked out, the soil is dug out for a spade's depth and thrown on either side of the trench in equal proportions. The loose soil at the bottom of the trench is also removed, and the ridge then formed is made smooth and shapely. A spreading of rotten manure is then put over the bottom, and is forked in so as to be completely covered by four or five inches of soil. The trench is then ready for the plants as soon as they are large enough.

CROPPING THE RIDGES.

The advantage of getting the trenches prepared in advance is that the ridge between the trenches can be cropped with some quick-growing

subjects, it being possible by planting immediately to get two such crops off the ridges before the soil is needed for earthing the celery. A row of spinach may be sown down the centre of each ridge and a row of lettuces planted on either side of the spinach. Lettuce plants from an early outside sowing will very soon be ready for this purpose. As soon as the spinach has been disposed of—namely, by the beginning of July—the old roots may be hoed up and the space planted with lettuce plants set at 9 in. apart. Thus we get two crops off the ridges before the soil is needed for earthing the celery.—LONDON TIMES.

THE CONTROL OF DISEASE BY DUSTING.

Apple growers will read with considerable interest the report* by MESSRS. D. REDDICK and C. R. CROSBY on the results of experiments in the use of "dust" instead of spray as a preventive of fungus and insect attack.

The dust employed consists of a mixture of finely powdered sulphur and arsenate of lead, the former as a fungicide and the latter as an insecticide. Tests carried out in many different orchards demonstrated that the sulphur should be as finely powdered as possible, and that the mixture should consist in 85 per cent. of sulphur and 15 per cent. of powdered arsenate of lead. The powder was applied at the rate of $1\frac{1}{4}$ to $2\frac{1}{2}$ pounds per tree by means of a power outfit operated by an old gasoline engine of 2 h. p. The diseases and pests which were effectively controlled by this method were Apple scab, sooty blotch (*Phyllachora pomigena*) and the codlin moth. The cost of application of the dust is less than that of spraying; but the materials used in the former are more expensive. The great advantages, however, which dusting has over spraying are, first, that the work can be done about four times quicker, and hence labour is not swallowed up at busy times; and, second, that dusting is less at the mercy of weather conditions than is spraying.

The authors point out that so far no dusting material has been discovered which will destroy aphis and Pear psylla, but they are hopeful that other powders may be discovered which will have these effects. In the meantime they claim that the dusting method gives the grower a means of protecting his orchard at critical times.

Dusting may be practised at any time of the day, though, naturally, still weather is more suitable than is windy weather. The materials may be mixed at home, and, if necessary, they may be diluted by means of some inert substance, such as hydrated lime or terra alba (powdered gypsum). When sulphur and arsenate of lead are used together no dilution is necessary, but if either is used separately, it is as well to add the inert substance in a finely powdered form; if arsenate of lead only is used, the diluting substance is necessary in order to give bulk and, if only sulphur is used, in order to improve its flowing qualities.

The only equipment required is a gasoline engine, and dusting and mixing machines. Where high trees are to be dusted additional lengths of outlet pipe will be required. Operators must be provided with goggles and must not take them off during the work. The results achieved by this method are so promising that we hope that it will receive a trial in this country. The labour expended on spraying is so considerable that, if dusting prove at all applicable to our conditions, the new method should prove a blessing to commercial fruit growers.

**Dusting and Spraying Experiments with Apples.* Bull. 369. Jan. 1916, Cornell Univ. Agric. Exp. Station of N. Y. State College of Agric.

MESSRS. REDDICK and CROSBY are of opinion that dusting will prove efficacious in the case of fruit trees other than the Apple, and we would suggest that the several researchers who are endeavouring to find means to rid us of American Gooseberry mildew should give this method a trial.—
GARDENERS' CHRONICLE.

THE DATE PALM IN EGYPT.

T. W. BROWN.

(*Continued from p. 118 Vol XLVII*)

INTERCALARY CROPS.

Doubts are sometimes expressed as to whether it is well to cultivate field crops on the land between the palms. Under the conditions which prevail in Egypt it is probably most profitable to do so. The presence of a ground crop usually ensures a better supply of manure and a more even distribution of water in summer. On the other hand crops such as cotton and maize must absorb a certain quantity of plant food which would otherwise be available for the nourishment of the trees. It is doubtful to what extent the yield of fruit is affected by the presence of the intercalary crops, and whether any increase brought about by growing the trees under the same conditions of manure and water but without the ground crops would compensate for the loss of the latter. These questions can only be settled by careful trials. The extent to which palms are affected by being watered in winter also requires investigation.

RATE OF GROWTH.

As soon as the newly planted off-shoots commence to put forth leaves the cover of canvas or straw is removed. In some cases this is so arranged that it may be removed automatically by the expanding leaves of the palm. The relative growth of date trees differs greatly, some varieties increasing in height much more quickly than others.

The number of leaves produced yearly varies between three and twenty-one according to the conditions under which the trees are growing and according to the variety. The comparative rate of growth, however, is not in accordance with the number of leaves put forth, on account of the fact that in some varieties the leaves are set much more closely on the stem than in other varieties. Thus in the case of trees of *Hayâni*, *Amhât*, and *Sîwi*, growing together under the same conditions, it was found that thirty leaves covered a space of about seventy centimetres on the stems of *Hayâni* and *Amhât*, whereas the same number of leaves covered a space of about fifty-five centimetres on the stem of the *Sîwi*. The *Hayâni*, however, is a variety of stronger growth than the *Amhât*, and usually produces more leaves than the latter. It therefore increases more quickly in height than the *Amhât* even though the spacing of the leaves on the stem is the same in the two varieties. The *Amhât*, on the other hand, produces the same number of leaves as the *Sîwi*, but it grows more quickly in height on account of their being set more widely apart on the stem than in the case of the *Sîwi*. Under normal circumstances the average yearly growth of the *Hayâni* is forty to forty-five centimetres, that of the *Amhât* is thirty-five to forty centimetres, and that of the *Sîwi* twenty- five to thirty centimetres. In years when very little fruit is produced the vegetative growths of the palms is naturally greater than in a year of a heavy crop. Male palms which bear no fruit increase in height more quickly than fruit bearing trees. Palms which are growing upon sandy land usually commnce bearing at an earlier stage than those growing upon rich land. In the former case they may be expected to bear fruit in the

fourth or fifth year from the time of planting, whereas in the latter case they usually bear their first crop in the sixth or seventh year.

Varieties, however, differ somewhat in this respect as in other characteristics. Thus the *Amhât* comes into bearing somewhat earlier than the *Hayâni*, whereas the *Sîwi* commences much later than either of the above.

MALE PALMS.

The date palms bear the male and female flowers on different trees. Almost all the male trees existing in Egypt have been grown from seed, but the parentage can often be recognized by means of the characters of the leaves and vegetative parts of the tree. Thus we heard cultivators speak of *Hayâni dakar*, *Sîwi dakar*, etc., i.e. *Hayâni* male, *Sîwi* male, etc. Male trees whose vegetative characters do not correspond with those of any named variety are known as *Baladi dakar*. Apart from the floral characters there are no natural differences between the male and female trees, but it is usually easy to pick out the male trees in an adult state by means of the persistent bases of the flower stalks which elongate after the spathes have been cut, and serve as distinguishing marks for the cultivator who is not familiar with the individual trees with which he is working. All male palms are not of equal value. The pollen of certain varieties is said to be more potent and active than that of other varieties, but this requires verification. There is no doubt, however, that many trees produce flowers which are entirely useless as fertilizing agents. Such trees are known as *Dakar Khunta* or *dakar farat*. Flowers from these are often sold in the market to inexperienced cultivators. They are, however, easily distinguished by their lack of the pollen. As a rule this is almost entirely absent. Even when the pollen is produced in small quantities it is defective. Attempts to make it germinate at Giza have invariably failed.

A male palm usually produces ten to thirty bunches (Ar. *kooz*, *pl. kizâne* of flowers, although strong trees may produce forty or even more. The number also varies somewhat according to the variety to which the tree belongs. The *Amhât* usually produces more than the *Sîwi* and *Hayâni*. Practically the same number of bunches are borne each year, there being no alternation of crops as in the case of the female palms. The early flowers commence to appear towards the end of February. The *kooz* is said to be ready for cutting if it opens along the margin on being bent. Some people cut the flowers in the evening and leave them in the dew for use the following morning. It is however, probable that equally good results are attained by cutting them in the morning when they are required. The spathe is opened as soon as it is cut and the branchlets separated from the rachis or main stem of the inflorescence. The early flowers which appear before those of the female palms, are dried in the sun for three to fours days, after which they are stored until required for use. It is said that they keep in good condition for a year if necessary. At the same time it is recognized that fresh flowers are superior to those which are dried, and the latter are only used if there is not sufficient fresh male flowers when the work of fertilization is in progress. At Aswân, the dried pollen branchlets are often soaked in water before being used. In some districts the male flowers are used twice if there is a scarcity. The price of the *kooz* when sold in the market varies between two milliemes and P. T. 5, according to its size and quality. Dried flowers are cheaper than fresh flowers. The early spathes are larger than those which are produced lower on the tree later in the season. A palm which is well cared for naturally produces larger spathes than one which receives very little water or manure. In the Delta one good male tree usually bears sufficient flowers to fertilize fifty female trees. In Upper Egypt, however, the cultivators use a much greater quantity of pollen flowers, consequently a larger proportion of male trees is required. The belief is

prevalent throughout Egypt that the sex of a male palm can be changed by cutting off the conical end of the underground part of the stem. I cannot, however, find any good evidence that this belief is based on fact.—AGRIC. JOUR. OF EGYPT.

DESTRUCTION OF TREES BY POISON.

ARSENIC AND SODA METHOD.

A subscriber wrote to THE FARMER AND SETTLER averring that arsenic was no good for tree-killing, as the trees suckered and the work had to be done all over again. The reply he received was that he had probably gone about the work in exactly the right way, but at altogether the wrong time. This paper has written literally hundreds of letters to landholders covering instructions for tree-killing; but has never known one failure in which there was not a certainty or at least a strong presumption that the arsenic was used when the sap was active in the tree. There are other possible causes of failure, but farmers are too accustomed to following plain directions to be likely to err in any other particular than in the matter of season. And the reason they fail at this point is because it is not possible to indicate precisely when poisoning, to be successful, should be done.

The time for poisoning, as previously stated, is when the tree is dormant —that is, when the sap movement is at its minimum and the sap down in the roots and lower portions of the trunk. This occurs in the winter months from, say, March to July, according to the district. On parts of the North Coast, ringbarking has been carried out to the best advantage as late as June and early July in certain years, whereas in the more central parts of the State, late February and March have generally found the sap movement at its lowest.

The main object in catching the sap to season is to prevent suckering. Trees can be killed by poisoning or ringbarking at practically any time of the year, but to prevent suckering it is highly important to operate when the sap is down, or just completing its downward course.

An officer of the New South Wales Department of Agriculture has put into condensed form the experience of thousands of landholders, and he gives this advice as to how to set about poisoning timber as a quicker and cheaper method of destruction than ringbarking.

TO DISSOLVE THE ARSENIC.

Ordinary arsenic is not very soluble in water, and soda—either in the form of washing soda or of caustic soda—has to be used to dissolve it. Ordinary washing soda requires to be used in the proportion of three of soda to one of arsenic, and boiling is necessary to bring about a complete solution. Caustic soda, which is much dearer, need only be used in the proportion of two of the soda to one of arsenic, and the heat generated, if a reasonable amount of water is added, is sufficient to obviate the necessity for boiling. For large quantities, washing soda is preferable, because the cheaper, but for small quantities caustic soda is perhaps better because it is handier.

THE MODE OF OPERATION.

In dissolving the arsenic, whether for washing or caustic soda solution, there is one point worth remembering: Do not tip the whole of the arsenic into the solution in a dry state, but mix it to a paste slowly and carefully, in the same way as the housewife treats her cornflour; then pour it slowly into a solution of the soda, stirring it all the time, and being careful to stand away from the fumes, as they are poisonous. When once the soda and arsenic are dissolved and chemically combined, the balance of the water can be added to make up the required quantity.

A useful strength for quick and effective work in all kinds of timber is a solution prepared on this formula: Arsenic, 1 lb.; washing soda, 3 lb.; or caustic soda, 2 lb.; water, 4 gallons; whiting, 1 lb. The whiting serves as an indicator on the trees treated, as it turns white on drying, making it quite certain what trees have been dealt with. An empty kerosene tin makes a useful measure for dissolving in, as it holds 4 gallons.

The tree that is to be operated upon is first rung with a "frill" ring. There is no doubt that "frilling" alone would kill timber if allowed time, but the poison does it in a fraction of the time—in fact, trees have been killed in a few days. The cuts must be through the bark and well into the wood proper, and they must be as close to the ground level as it is convenient to make them, consistent, of course, with the shape of tree; say, from 6 in. to 10 in. up.

For trees of 4 ft. diameter about a quart of solution is poured into this frilling, right around the tree, using an old teapot or kettle, as the spout makes pouring easy and less is wasted by spilling. Smaller trees, of course, need less solution.

Saplings may be cut off low down, and the solution may be dabbed on with a swab stick to kill and prevent suckering.

It is very important that this frilling and poisoning be consistently and thoroughly carried out, and not in any way scamped or slummed, if good results are to be looked for.

No fears need be entertained about stock being poisoned by eating the fallen or dead leaves from treated trees, and there is not much danger if they are even allowed to remain on the area; but to make sure it is desirable that all live stock should be excluded for three or four weeks.

THE QUESTION OF COST.

Estimates of cost are hardly likely to be of use, as there are several factors that vary with the district. A recent report of the manager of the new Condobolin Government demonstration farm records that poisoning was adopted there with success and economy. The work was done by day labour at a total cost of 1*s.* 5*d.* per acre. This must be considered very low, as the country was fairly heavily timbered, and the wages were from 1*s.* to 1*s.* 4½*d.* per hour. Said the manager: "The timber has all died, and mostly within forty-eight hours from the time of ringing."

The liquid was distributed by means of 1½ gal. watering cans with spouts made specially long, and having exit holes about the size of a No. 8 wire.—QUEENSLAND AGRICULTURAL JOURNAL.

PANICUM SANGUINALE OR FALSE CEBADILLA, A WILD FORAGE PLANT IN PARAGUAY.

G. T. BERTONI.

Panicum sanguinale is one of the best wild forage plants in Paraguay. It is an annual of rapid growth and spreads rapidly. It succeeds on the most diverse types of soil, but not in low inundated lands or very dry, sterile soils. The forage is tender, palatable and of great nutritive value and very suitable for making hay which is very compressible. The young plant contains about 80 per cent. of water and in the dry state its percentage composition is as follows :—

Ash ...	... 17·23	Fat ...	... 2·84
Total nitrogen	... 3·32	Cellulose	.. 26·11
Protein	... 20·75	Carbohydrates	... 33·32

Although this plant is an excellent forage when obtained as a wild crop, it can hardly be recommended for cultivation on account of its spreading character, lack of resistance to treading down, and difficult harvesting. Also on account of its high moisture content it cannot be fed green.—BULL. INTERNAT. INST. OF AGRIC.

[*Panicum sanguinale* is a common Ceylon grass.—Ed.]

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	100/ a 110/
Zanzibar & Hepatic ,,	Common to good	60/ a 100/
ARROWROOT (Natal) lb.	Fair to fine	3½d a 4d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 17/6
East Indian, bleached ,,	Fair to good	£8 10/ a £8 15/
,, unbleached ,,	Dark to good genuine	£6 a £6 12/6
Madagascar ,,	Dark to good palish	£7 a £7 15
CAMPHOR, Japan lb.	Refined	2/4½ a 2/6
China cwt.	Fair average quality	155/ nom.
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6
per lb.	Middling lean	2/ a 2/9
Malabar, Tellicherry ,,	Good to fine bold	3/6 a 4/6
Calicut ,,	Brownish	2/ a 3/
Mangalore ,,	Med Brown to good bold	3/ a 5/10
Ceylon, Mysore ,,	Small fair to fine plump	1/8 a 5/6
Malabar ,,	Fair to good	1/7 a 1/8
Seeds, E. I. & Ceylon ,,	Fair to good	1/7 a 1/8
Ceylon "Long Wild" ,,	Shelly to good	1/ a 1/6 nom.
CHILLIES, Zanzibar cwt.	Dull to fine bright	100/ a 110/
Japan ,,	Fair bright small	80/ a 89/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5½d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Fair to fine quill	11d a 1/6
per lb. 2nds.	,, ,,	10d a 1/5
3rds.	,, ,,	9d a 1/3
4ths.	,, ,,	8d a 1/
Chips,	Fair to fine bold	3d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1/2
Amboyna ,,	Dull to fine	10½d a 11d
Zanzibar ,,	Fair and fine bright	7½d a 7¾d
Madagascar ,,	Fair	7½d
Stems ,,	Fair	1¾d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	,,
COCOA, Ceylon Plant. ,,	Special Marks	85/ a 90/6
	Red to good	78/ a 84/
Native Estate ,,	Ordinary to red	57/ a 82/
Java and Celebes ,,	Small to good red	70/ a 98/
COLOMBO ROOT ,,	Middling to good	32/6 a 40/
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	160/ a 180/
GINGER, Bengal, rough ,,	Fair	35/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	50/ a 70/
Cochin, Rough ,,	Common to fine bold	40/ a 47/6
	Small and D's	40/
Japan ,,	Unsplit	38/
GUM Ammoniacum ,,	Ord. blocky to fair clean	60/s a 85s
Animi, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
Arabic, E. I. & Aden ,,	Ordinary to good pale	45/ a 55/ nom.
Turkey sorts ,,	... ...	62/6 a 65/
Ghatti ,,	Sorts to fine pale	20/ a 32/6
Kurrachee ,,	Reddish to good pale	25/ a 35/ nom.
Madras ,,	Dark to fine pale	20/ a 32/6 nom.
Assafœtida ,,	Clean fr. to gd. almonds	£15 a £20
	com: stony to good block	£4 a £10
INDIGO, E.I. Bengal lb.	Shipping mid. to gd. violet	14/6 a 15/6
,,	Consuming mid. to gd.	13/9 a 14/6
	Ordinary to middling	12/6 a 13/6
,,	Mid. to good Kurpah	8/9 a 11/
,,	Low to ordinary	6/6 a 8/6
,,	Mid. to fine Madras	4/6 a 5/6
KAPOK-Ceylon lb.	Ordinary to good	5½ a7d
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	60/ a 70/
Somali ,,	,, ,,	50s a 60s
MACE, Bombay & Penang		
per lb.	Pale reddish to fine	1/10 a 2/
	Ordinary to fair	1/8 a 1/10
Java	,, ,, good pale	1/10 a 2/
Bombay	Wild	5d

	QUALITY.	Quotations.
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	1/6 a 1/9
	80's	1/2
	110's	10d
NUX VOMICA, Cochin	Ordinary to good	20/ a 23/
per cwt. Bengal	,, ,,	18/ a 20/
Madras	,, ,,	18/ a 21/
OIL OF ANISEED lb.	Fair merchantable	3/5½
CASSIA ,,	According to analysis	3/10 a 4/1
LEMONGRASS oz.	Good flavour & colour	1¾d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	5d a 1s 6d
CITRONELLE lb.	Bright & good flavour	2/
OLIBANUM, drop ,,	Good to fine white	55s a 60s
,,	Middling to fair	45s a 50s
pickings ,,	Low to good pale	20/ a 35/
siftings ,,	Slightly foul to fine	25s a 35s
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	8¾d
Ceylon ,, ,,	Fair to fine bold-heavy	8d a 8½d
Singapore ...	Fair	7⅞d
Acheen & W. C. Penang	Dull to fine	nom.
(White) Singapore ,,	Fair to fine	9½d a 10d
Siam ,,	Fair	9¾d
Penang ,,	Fair	9¾d
Muntok ,,	Fair	9⅞d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 3/
Canton ,,	Ordinary to good	1/6 a 2/3
High Dried,,	Fair to fine flat	1/3 a 1/4
	Dark to fair round	7d a 8d
RUBBER, INDIA lb.	Fine Para smoked sheets	2/3
Ceylon, Straits, ,,	Crepe ordinary to fine	2/3½
Malay Straits, etc. ,,	Scrap fair to fine	1/9½
Assam ,,	Fair 11 to ord. red No. 1.	1/6½
Rangoon ,,	,, ,, ,,	1/7½
Borneo ,,	Common to good	1/7½
Java ,,	Good to fine red	1/10
Penang ,,	Low white to prime red	1/6 a 1/7
Mozambique ,,	Fair to fine red ball	2/1
,,	Sausage, fair to good	2/1
Nyassaland ,,	Fair to fine ball	1/11
Madagascar ,,	Fr. to fine pinky & white	1/6
,,	Majunga & blk coated	1/3
,,	Niggers, low to good	9d a 1/2
New Guinea ,,	Ordinary to fine ball	1/9 a 2/
SAGO, PEARL, large--cwt	Fair to fine	24/6 a 25/
medium ...	,, ,,	24/6 a 25/
small ...	,, ,,	21/ a 23/
Flour ...	Good pinky to white	18/ a 19/
SEEDLAC cwt.	Ordinary to gd. soluble	55/ a 90/
SENNA, Tinnevelly lb.	Good to fine bold green	1/ a 1/1½
	Fair greenish	10d a 11d
	Common specky & small	6½d a 8½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	50/ a £5 10/
Bombay ,,	,, ,,	60/ a £5 10/
Mergui ,,	Chicken to bold	£6 10/ a £10 10/
Manilla ,,	,, ,,	£6 10/ a £10
Banda ,,	Sorts	30/
Green Snail ,,	Small to large	55/ a 75/
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	25/ a 26
per cwt. Madras	Inferior to good	Nominal.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
Ceylon	Small to bold	10/ a 20 nom.
TURMERIC, Bengal cwt.	Fair	35/
Madras ,,	Finger fair to fine bold	35/ a 37/6
Do. ,,	Bulbs ,, ,, [bright	23/
Cochin ,,	Finger fair	35/ nom.
	Bulbs ,,	25/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	7/ a 12/
Madagascar ... } 2nds.	Foxy & reddish 3½a ,,	6/6 a 7/6
Seychelles ... } 3rds.	Lean and inferior	5/6 a 6/
WAX, Japan, squares, cwt.	Good white hard	67/6

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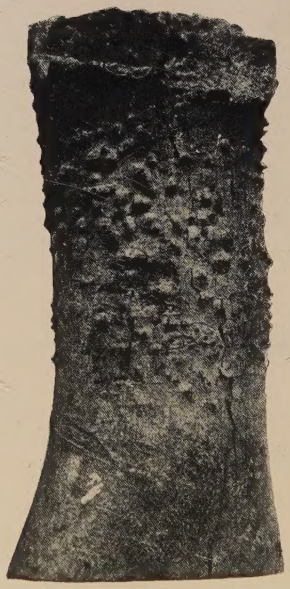

Photo by T. Petch.

A STEM DISEASE OF TEA.

(*Aglaospora aculeata.*)